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PROCEEDINGS OF SOCIETIES.

THE AMERICAN SCIENCE ASSOCIATION.

The twenty-ninth meeting of the American Association for the Advancement of Science began in Boston, August 25. The meeting was called to order by the retiring President, Prof. George F. Barker, of Philadelphia, who immediately resigned the chair to the President-elect, the Hon. Lewis H. Morgan, of Rochester. President Rogers, of the Massachusetts Institute of Technology, delivered an introductory address, which was followed by addresses of welcome by Mayor Prince and Governor Long.

The secretary reported the deaths for the past year as follows: George W. Abbe, New York; E. B. Andrews, Lancaster, Ohio; Homer C. Blake, New York; Caleb Cooke, Salem, Mass.; Benjamin F. Mudge, Manhattan, Kansas; Thomas Nicholson, New Orleans; Louis Francis de Pourtelas, Cambridge, Mass.

A committee was appointed to draft resolutions on the death of Gen. Albert J. Myer, and another to send by cable the cordial greetings of the Association to the British Association at Swansea, on the occaaion of its fiftieth meeting.

The general session was then adjourned, and the various sections and subsections organized. In the afternoon, Section A was addressed by Prof. Asaph Hall, of Washington, who reviewed the recent advances in the science of astronomy, and the services rendered by men who, like Fraunhofer, have aided the work by optical and mechanical skill.

In the sub-section of chemistry, Prof. John M. Ordway reviewed the recent

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achievements of practical chemistry, and discussed its methods. The sub section of anthropology was addressed by Major J. W. Powell, on the social organization and government of the Wyandotte Indians. In the evening, the retiring President, Prof. Barker, delivered the customary address, his subject being, "Some Modern Aspects of the Life Question." He took the ground that every action of the living body is, sooner or later, to be recognized as purely chemical or physical, the life that science has to deal with having no existence apart from matter.

The second day's meetings were held in Harvard College, Cambridge. The appointed eulogy on the late Prof. Henry was delivered by Prof. Alfred M. Thayer, who dwelt especially on Prof. Henry's work as a discoverer in science. The practical side of that work was touched in connection with the experiments which proved so beneficial to the light-house and fog-signal service. One discovery—that lard oil, when subjected to a heat of 280° Fahr., is superior to sperm oil in fluidity and illuminating power—saves the government $100,000 a year.

Prof. Alexander Agassiz, Vice-President of Section B., followed with an address on "Paleontological and Embryological Development," choosing his illustrations from a limited group of marine animals—*zaurchins*—having less than 300 living species, and more than 2,000 known fossil species.

The rest of the day was spent in the museums, laboratories, libraries, the observatory, and other buildings of Harvard College.

The reading of the 218 papers comprised in the programme was to begin on the third day, Friday, and continues until the final adjournment on Wednesday, September 1. Nearly 600 members were registered the first day, and fully 500 new members have been elected during the two days completed at this writing.—*Scientific American.*

THE BRITISH SCIENCE ASSOCIATION.

The fiftieth meeting of the British Assosiation, commenced on Wednesday at Swansea, and is likely to be a very successful gathering, the number of tickets issued up to that evening being 790, whilst the list of visitors is likely to be considerably increased. There was a large attendance in the Music Hall to hear the address of the President-elect, Professor Andrew Crombie Ramsay, Director-General of the Geological Survey of the United Kingdom. Upon the platform were professor Allman, the retiring President, Mr. Hussey Vivian, M. P., and many other well-known scientific gentlemen. The Mayor of Swansea having given the Association a hearty welcome to the greatest tin manufacturing county in the world, Prof. Allman resigned the chair, and introduced Prof. Ramsay as his successor.

Professor Ramsay having assumed the chair, proceeded to deliver his inaugural address. He said the chief object of this address was to attempt to show that whatever might have been the state of the world long before geological his-

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tory began as now written in the rocks, all known formations were comparatively so recent in geological time that there was no reason to believe that they were produced under physical circumstances differing either in kind or degree from those with which we were now more or less familiar. All, or nearly all stratified formations had been in a sense metamorphosed, excepting certain limestone: the fact of loose, incoherent sediments having been by pressure and other agencies turned into solid rocks, constituted a kind of metamorphism. Common stratified rocks chiefly consist of marls, shales, slates, sandstones, conglomerates and limestones, generally distinct and definite; but not unfrequently a stratum or strata might partake of the characters in varied proportions of two or more of the above named species.

He would not discuss the theory of the causes which produced the metamorphism of stratified rocks; but he might say that under the influence of deep underground heat, aided by moisture, sandstones had been converted into quartzites, limestones had become crystalline, and in shaly, slaty and schistose rocks under like circumstances there was little or no development of new material, but rather in the main a rearrangement of constituencies according to their chemical affinities in rudely crystalline layers, which had been very often more or less developed in pre-existing planes of bedding. In Cornwall, Devonshire and Ireland it was now well known that metamorphic rocks were common, and the cases of metamorphism of Silurian rocks on the Continent could be easily multiplied. The same kind of phenomena were common in Canada, the United States and India. Turning to the Devonian and old red sandstone strata of England and Scotland, he found that metamorphic action had also been at work, but in a much smaller degree. These rocks were of the same geological age, though they were deposited under different conditions, the first being of marine and the latter of freshwater origin. With regard to the carboniferous strata, he knew of no case where there had been a thorough metamorphism in Britain except that in South Wales, beds of coal in the west of Carmarthenshire and in South Pembrokeshire gradually passed from so-called bituminous coal into anthracite. He knew of no other strata that had suffered from metamorphic action, and he had never seen or heard of metamorphic rocks of later date than those that belonged to the Eocene series.

Enough, however had been said to prove that from the Laurentian epoch onward, the phenomenon of extreme metamorphism of strata had been of frequent recurrence, and extended partly to the Eocene series, equivalent to the soft, unaltered strata of the formations of the London and Paris basins, which, excepting for their fossil contents and sometimes highly inclined positions, looked as if they had only been recently deposited. Referring to the subject of volcanoes, the President said that the oldest volcanic products he knew of were of lower Silurian age, and they were to be found in Wales and other parts of England, but he knew of no true volcanic rock in the Upper Silurian series. In the Old Red Sandstone of Scotland lavas and volcanic ashes were of frequent occurrence,

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and they were also to be found throughout nearly the whole of the carboniferous sub-formations, as well as being associated with Permian strata in that country.

Volcanic rocks also existed in the Devonian strata of Devonshire, but he knew of none in America or on the Continent, and the only instance of a volcano of Eocene age known to him was that near Verona. There were, however, well preserved relics of Miocene volcanoes over many parts of Europe, and the evidence was clear that in nearly all geological ages they had played an important part, now in one region and now in another; and so far as his knowledge extended, at no period of geological history was there any sign of their having played a more important part than they did in the present epoch. The mountain chains of the world were of different geological ages, some of them being of great antiquity, and some of them comparatively modern. It was well known that in North America the Lower Silurian rocks lay unconformably upon the Laurentian strata, and the disturbances which had taken place implied beyond a doubt that the Laurentian rocks formed a high mountain chain of pre-Silurian date, which had since constantly been worn away and degraded by sub-ærial denudation. It would not be difficult to add other cases of recurrences of the upheaval and origin of special mountain chains, some of which he could speak of from personal knowledge; but enough had been said to show the bearing of this question on the argument he had in view, namely, that of repetition of the same kind of events throughout all known geological time. The recurrence of rock and other salts strengthened his view. To give anything like a detailed account of all the fresh-water formations deposited in estuaries and lakes from the close of the Old Red Sandstone times down to late Tertiary epochs would be impossible in that address, but it might safely be inferred that something far more than the rudiments of our present continents existed long before Miocene times, and this accounted for the large areas of those continents, which were frequently occupied by Miocene fresh-water strata. With the main formations of Miocene age he was not now concerned, nor was it essential to his argument to deal with those later Tertiary phenomena, which in their upper stages so easily merged into the existing state of the world. The last special subject for discussion was the recurrence of glacial epochs, a subject still considered to be heretical by many, and which was generally looked upon as an absurd crotchet when in 1855 he first described to the Geological Society boulder beds containing ice-scratched stones and erratic blocks in the Permian strata of England. The same dea he afterward applied to some of the old red sandstone conglomerates, and of late years it had become so familiar, that the effect of glaciers had at length been noted by geologists from older paleozoic epochs down to the present day.

The conclusions he arrived at were these. In opening his address he began with the subject of the oldest metaphoric rocks that he had seen, the Laurentian strata, the deposition of which took place far from the beginning of recognized geological time, for there must have been older rocks by the degradation of which they were formed. Starting with the Laurentian rocks, he had shown

that the phenomena of metamorphism of strata had been continued from that date all through the later formations or groups of formations down to and including part of the Eocene strata in some parts of the world. He had also shown that ordinary volcanic rocks had been ejected in Silurian, Devonian and other times, and from all that he had seen and read of these ancient volcanoes he had no reason to believe that volcanic forces played a more important part in any period of geological time than they did in this modern epoch. So also mountain chains existed before the deposition of the Silurian rocks, other of later date before the old red sandstone strata were formed, and the chain of the Ural before the deposition of the Permian beds. The deposition of salts from aqueous solutions in inland lakes and lagoons appeared to have taken place through all time and was still going on, and in like manner fresh water and estuarine conditions were found now in one region, now in another, throughout all the formations, or groups of formations, possibly from Silurian times onward, whilst what was termed the glacial epoch was now boldly declared to have occurred at intervals from almost the earliest Paleozoic times down to our last post-Pliocene "glacial epoch."

If the nebular hypothesis of astronomers be true—and he had no reason to doubt it—the earth was at one time in a purely gaseous state and afterward in a fluid condition, attended by intense heat. By and by consolidation, due to partial cooling, took place on the surface, and as radiation of heat went on the outer shell thickened. Radiation still going on, the interior fluid matter decreased in bulk, and by force of gravitation the outer shell, being drawn toward the interior, gave way, and in parts got crinkled up, and this, according to cosmogonists, was the origin of the earliest mountain-chains. This looked highly probable. But assuming that it was true, these hypothetical events took place so long before authentic geological history began, as written in the rocks, that the earliest of the physical events to which he had drawn their attention was to all human apprehension of time so enormously removed from these early assumed cosmical phenomena that they appeared to him to have been of comparatively quite modern occurence, and to indicate that from the Laurentian epoch down to the present day all the physical events in the history of the earth had varied neither in kind nor in intensity from those of which we now had experience. Perhaps many British geologists held similar opinions, but if that were so, it might not be altogether useless to consider the various subjects separately on which he depended to prove the point he had in view.—*Iron.*

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ANTHROPOLOGY.

TERTIARY MAN.

TRANSLATED FROM THE FRENCH OF ZABOROWSKI, BY E. L. BERTHOUD, A. M.

(*Continued from June Number.*)

We do not believe it is possible to claim or admit that in this continued succession of changes, physical as well as organic, that man alone has remained unchanged, especially when we reflect that changes in living beings are more rapid in direct proportion to their more complicated organization.

Hence to suppose that the flint tools of Thénay may have been fashioned by a human being as far advanced, or rather we might better say, as highly developed as our present human races, is absolutely contrary to the fundamental laws of development, or the best recognized facts of palæontology.

In view of this consideration, and its incontestable force, the formation of these flint tools has first been by M. de Mortillet, attributed to a being whom he calls the "precursor of man," in its widest sense; that is to say, not only in the category of individual or species, but in that of a genus preceding man, from which could have sprung at least two types of human races.

M. Hovelacque has attempted an anatomical restoration of this presumed precursor to man after a comparison of anthropomorphous apes and the most ancient races of men, on the assumed explanation of their derivation from a common ancestor. We have no space now for a detailed account or analysis of this attempt; but suffice it to say it is well worthy of our attention, although hazardous from the present state of our knowledge on these points. But this comparison in itself is based on facts rigorously exact, and to-day admitted by Science.

When in 1874 we noticed and proclaimed this precursor of man as the author of the chipped flint tools of Thénay; we then admitted that our present knowledge of facts bearing on this question did not allow us to affirm that the human and simian branches were or were not separated in the Miocene epoch: and that with this being the true precursor of the human race, we indicated or mentioned the hypothesis of a varied *being*, a *species* not yet fully established, that we called then "Anthropiskes," (future men) among whom could have been operated a return to a type purely Simian.

Agreeing in this with Schleicher, who supposed that a certain number, or certain species of Anthropiskes had acquired under circumstances more or less favorable, the power of articulation, and had thus become men, while other branches of this genus less favored, had remained unchanged, had retrograded,

even thus constituting in time the four present species of anthropomorphous apes.

We can also here remark that the flints of Thénay do not seem to have been fashioned for any special service or destination; they, perhaps, may have been split out by the action of fire, or accidentally, but thanks to this accidental formation, those who used them in their rough state were led little by little to fashion them into shape intentionally.

There are numerous instances that prove that monkeys nowadays know how to use pebbles and sticks. The most curious trait that we know, is related by Darwin of a monkey who used the same stone to break filberts constantly; and that he kept it hid in the straw.

After that we have not been at all surprised when we saw that M. Gaudry in a recent work declared that the most natural idea that presented itself to his mind was, that the flint tools of Thénay had been fashioned (taillés) or chipped, by the ancient Dryopithecus, this being exactly the big anthropomorphous ape discovered by Foutan, at St. Gaudens in France, and described by Mr. Ed. Lartet.

Unhappily we, as yet, possess only a lower jaw and a humerus. From an examination of these fragments, M. Gaudry concluded that he resembled man by several peculiarities. First by its size, which is very important, then by its incisors, and also by the rounded form of the rear molar protuberances, very similar to the molar teeth of Australians. But the size of the pre-molars and canines naturally produced extreme prognathism, or large advance of the face. This mark of inferiority, however, does not appear very striking, but we are much impressed with the general human aspect of the jaw, which M. Gaudry gives in a full sketch, which appearance is due not only to the broken canine, but to the contour of the chin, which, instead of giving a re-entering angle like apes, is almost straight, or like the human jaw from La Nanlette. M. Gaudry, however, does not notice this peculiarity.

We think it is sufficient at this time to pronounce it as certain that the human species, properly so called, did not exist in the Miocene epoch. Did it then exist in the Pliocene epoch? We can doubt this at least for the older Pliocene.

ANCIENT MAN IN MISSOURI.

The finding of numerous relics of a buried race, on an ancient horizon, from twenty to thirty feet below the present level of country in Missouri and Kansas, was noted in this paper a few months ago. The St. Louis *Republican* gives particulars of another find of an unmistakable character made last spring in Franklin county, Missouri, by Dr. R. W. Booth, who was engaged in iron mining about three miles from Dry Branch, a station on the St. Louis and Santa Fe railroad. At a depth of eighteen feet below the surface the miners uncovered a human skull, with portions of the ribs, vertebral column, and collar bone. With them

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were found two flint arrow heads of the most primitive type, imperfect in shape and barbed. A few pieces of charcoal were also found at the same time and place. Dr. Booth was fully aware of the importance of the discovery and tried to preserve everything found, but upon touching the skull it crumbled to dust, and some of the other bones broke into small pieces and partly crumbled away, but enough was preserved to fully establish the fact that they are human bones.

Some fifteen or twenty days subsequent to the first finding, at a depth of twenty-four feet below the surface, other bones were found—a thigh bone and a portion of the vertebra, and several pieces of charred wood, the bones apparently belonging to the first found skeelton. In both cases the bones rested upon a fibrous stratum, suspected at the time to be a fragment of coarse matting. This lay upon a floor of soft but solid iron ore, which retained the imprint of the fibers.

Overlying the last found bones was a stratum of what appeared to be loam or sod, from two and a half to three inches thick, below which was a deposit of soft red hematite iron ore, lying upon two large boulders of hard ore standing on edge, standing at an angle of about forty-five degrees, the upper ends leaning against each other, thus forming a considerable cavity which was filled with blue specular and hard red ore and clay, lying upon a floor of solid red hematite. It was in this cavity that the bones, matting and charred wood were found, intermixed with ore.

The indications are that the filled cavity had originally been a sort of cave, and that the supposed matting was more probably a layer of twigs, rushes, or weeds, which the inhabitants of the cave had used as a bed, as the fiber marks cross each other irregularly. The ore bed in which the remains were found, and part of which seems to have formed after the period of human occupation of the cave, lies in the second (or saccharoidal) sandstone of the Lower Silurian.—*Scientific American.*

THE SYNTHETIC PHILOSOPHY.

ITS ASPECTS AS A PHILOSOPHY.

W. H. MILLER, KANSAS CITY.

Nature, as man finds himself situated in it, presents the aspects of infinite extension, infinite multiplicity of forms, infinite activity and changeableness, infinite constancy of continuance and of laws of continual change. It enters into his conceptions as absolute in itself, or as containing a principle that is absolute from whence it proceeds and by which its activity is governed by infinite constant and immutable laws. Thus environed, man finds himself endowed with

an insatiable longing to resolve the mystery of the environment, to know what it is, from whence it came, what its destiny, and what the purpose of its being.

The record man has preserved of himself in history recounts his efforts to resolve it and their results in mythology, theology and philosophy, each system of which has been partly accepted by one generation only to be rejected by another. Even anterior to the historic period, we find man had addressed himself to the same profound problem, for at the beginning of history he had his beliefs in gods to whose agency he attributed it. These beliefs stand for the net results of the efforts of pre-historic man; for mythology, as well as theology, are of the same nature as philosophy in so far as they attempt to account for the phenomena of things. Mythology and theology, however, in all the innumerable forms in which they have been presented, have been found inadequate to command universal acceptance, and to satisfy human longings. They begin by assuming gods, or a God, to whom the phenomena are due. This only transfers the mystery, for with such an explanation, which does not explain the phenomena of nature or of man, he becomes as eager to know of the gods, or God, as he was to know of nature. Yet to this conclusion, that there is a supreme being, infinite and absolute, whether we call it gods or God, the conditions of human intelligence force it by an irresistible necessity, while the emotional nature equally presses to the same end for something supreme and immutable as an object worthy of worship. To explain this supreme being is the function of philosophy and religion—the one revealing its aspects as related to nature, and the other as related to the moral aspects of man.

To consider the necessity man feels of an adequate explanation, the unceasing struggle he has made to find one, and his repeated failures, is to be filled with pity for his distressing situation and the misfortune that attends his struggles. As the *ignis fatuus* lures the lost traveler into impenetrable darkness and mire, nature leads man, bound by a spell he cannot break and lured by hopes it seems he cannot realize, into the depths of impenetrable mystery.

Mythology, having failed, has nearly vanished before the more definite forms and comprehensive scope and unity of theology. Theology, in offering no explanation of supreme being in itself and as related to nature, and only of its relations to the moral aspects of man, is not adequate; and the explanations it offers are distrusted by most, for how can relations be certainly explained and known until reality to which they relate is known? Philosophy, based upon the necessary conditions of things, has been found inadequate in its most elaborate and comprehensive forms, and does not satisfy. Hence the mystery remains.

In this situation man has taken to the study of nature itself, hoping that by sitting as a little child humbly at her feet, and patiently learning the lessons she teaches, to find the desired solution. In this much progress has been made; all departments of nature have been penetrated—astronomy, geology, chemistry, physics and naturalism in all their branches, and it is found that all teach the same lessons of infinite and immaculate laws, which reduce nature, with all its

apparent heterogeneity to a consistent unity. These laws, founded as they are upon the accepted inductions of science, must be accepted as true. They too, like mythology, theology and the philosophy of the necessary, point to a supreme being that is infinite and absolute. Upon the inductions of science, serving as foundation for these laws, has been founded, also, the evolution hypothesis, which, during the past century has been so widely accepted by scientific men. To unify and explain nature by these laws, and in accord with the evolution hypothesis, is the purpose of the Synthetic Philosophy of Mr. Herbert Spencer, of which a republication in this country has been made during the current year. To examine this philosophy, as such, is the purpose of this paper.

It begins with an analysis of the teachings of science and religion, in which it is shown that the ultimate idea of both is that there is absolute and infinite being. It then explains that all knowledge of which man is capable is relative, and hence, as absolute and infinite being is not relative, knowledge of it transcends human power. Here the system might be charged with a grievous fault, for it is no explanation of a thing to say that it is unknowable. The conditions of philosophy are not complied with, and its function, which is to explain, is not discharged. Man's longing for knowledge is not satisfied, and if the conclusion be true, he is condemned to a most cruel fate in being compelled perpetually to seek to know that which is unknowable.

But to dismiss the subject here, as might justly be done, would not do justice to the merits and demerits of the system, both of which it possesses in large measure. It next explains that our idea of space is an abstract of our experiences of co-existent, resisting position. That is, that we continually meet with things in nature that occupy positions and resist our energies, and that by mentally abstracting these things from the positions occupied and leaving positions that do not resist, we attain the idea of space, or position that offers no resistance. Experience of force is, therefore, the foundation of our idea of space, whence it is concluded that force is the real being here met with. A similar analysis is made of our idea of time. Here the resisting positions, from experience with which the idea is derived, are successive instead of simultaneous. Hence here, also, our idea is an abstract of experience of force, and force is the being underlying it. Motion is shown to be only the sensible sign of something that moves, and as moving involves the exercise of force, force is here also the real being experienced. In regard to matter, it is shown that our knowledge of it arises from our experience of its resistance of our energy and its power to so affect us as to produce sensation. The ultimate reality in matter is, therefore, force. From these considerations it is concluded that the real being in nature, its ultimate, absolute principle, is force. That principle in man which is commonly known as the soul is manifest to us, it is claimed, as a force. It has activity, which implies force, and exhibits a form of motion which we know as intelligence. Therefore force is here the reality, and hence it is concluded that force is the ultimate principle of the universe, the real being that is infinite and absolute.

These inductions are presented as philosophy, not as science, and are not, therefore, to be classed with the accepted inductions of science which reveal the laws of phenomenal nature. They are super-scientific, and bring us up to the level of mythology and theology, which find in gods, or God, the ultimate, absolute and infinite principle of nature. It brings us also up to the level where philosophy finds its real problem—this ultimate, absolute, infinite first principle which it is its function to explain. But when we look to this evolution philosophy for such explanation we are disappointed. It tells us that force is inscrutable and thus, instead of satisfying the yearnings of humanity, it falls into absurdity by explaining all that is known into the unknown and unknowable, and thus makes the mystery it set itself to resolve, deeper and darker than it found it. Nor is this all; any system of philosophy must be consistent with itself. Here we are told on the one hand that force is wholly inscrutable, and on the other that it possesses activity, a number of most general laws of action, to explain which, as producing evolution, is the purpose of this philosophy. Now, if all knowledge is relative, it is necessary to think that being possessing these, or any other qualities, by which it may be known is not inscrutable. Either it is not unknowable, or it does not possess relations whereby it is known.

Here again it might be dismissed as philosophy were it not that it has not exhausted its material. There are inductions unmade that even an ordinary mind can supply, and perhaps many may supply to the detriment of truth. Let these be supplied and see if it will help it out of its absurdity.

Force being the ultimate principle in man and the ultimate, absolute and infinite principle in nature, both are the same, except that the one is special and the other general. Whatever qualities it exhibits in its special form, it must possess in its general form, for the general form being absolute and infinite must be the source of all qualities of the special form; there is no other source from which they could be derived, and to hold otherwise is absurd. Therefore when the special form exhibits a mode of motion that constitutes what we know as intelligence, will and emotion, that mode of motion must be exhibited also by the general form, and the conception at which we thus arrive is that of force as a personal deity infinite and absolute.

But if it be held that the mode of motion we know as intelligence in man is a modified form of motion resulting from the interaction of different forms of force, then there are deductions that apply. Let these be supplied and see if they will help this philosophy out of its absurdity. If force be the ultimate principle in nature, that of which all other things are composed, it seems necessary to conceive it as having existed in a pure state before things were evolved from it. In that case it seems equally necessary to conceive that force determined to organize things, and that it established laws that govern them. To have done this manifestly required the exercise of absolute will and infinite intelligence. And as will and intelligence cannot be conceived except as associated with conciousness, we find ourselves brought again to the conception of force as personal deity, infinite and absolute.

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But as evolution denies creation, it may hold that there never was this semblance of it, but that force has existed from all eternity in an organized form, oscillating between a definite heterogeneity as we see it now, and an indefinite comparative homogeneity as in the nebulous state. This appears to be the doctrine really taught. Let this be granted and a different deduction applies. For in that case force exhibits an infinite variety of conditions, qualities and determinations. As infinite and absolute being it must be held to determine from time to time, and from form to form, the conditions, qualities and determinations to be assumed, which necessarily involve the constant exercise of absolute will and intelligence, hence consciousness, hence personality, and hence the conception of force as personal deity, infinite and absolute.

But it may be held that these conditions, qualities and determinations are not thus established, but are imposed upon force by the concrete and dependent forms it assumes, in which case we must conceive dependent being as having power to condition independent being, which is absurd. But if it were true, the conditions, qualities and determinations could be imposed only by consent of the independent being, and consent implies intelligence to consider and will to yield, hence consciousness, and hence a conception of force as personal deity infinite and absolute.

Or it may be held that the conditions, qualities and determinations are not the result either of self-establishment or of establishment by the dependent forms, but are the result of inter-action between the different forms. If this were true, it would yield us the conception of a world ruled by chance, which is manifestly not true, or force us to abandon all conceptions of force as the ultimate principle of nature.

But had this philosophy adopted any or all of these inductions and deductions, which are here shown to be possible to it, it would still be open to the fatal objection that force is known to be, not a thing in itself—a real entity—but only a quality of being. As motion is the sign of something that moves, so force is the quality that makes it move. Here the question arises, why is force of all the qualities of being, assumed as ultimate being itself? It is one of the best known of the qualities of being, as this philosophy shows in formulating its laws. It is also one of the most variable qualities, for some forms of being possess it in high degree, as dynamite, while others possess it in such low degree that to determine that they have more than mere gravitation, it is necessary to put them through a metamorphosis, whereby we cannot be certain if the force we develop resided primarily in the thing or was communicated to it by the metamorphosis. It is far less constant than the quality of existence, which belongs to all being equally, and it is less inscrutable, for existence can be defined only in terms of itself. To erect this quality into ultimate being would be as absurd as those primitive Grecian philosophies that thus erected fire, air, water and number into ultimate being, but not so absurd as thus to regard force because force is so much less constant.

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Hence, the conclusion that evolution as a philosophy is a failure, not only in the form presented by Mr. Spencer, but in all forms in which it may be presented, so long as it presents force as the ultimate principle of nature, is irresistible. Yet it rests upon accepted induction of science, and upon laws that seem to explain and unify them. It is offered as a scientific doctrine and as a reasonable and conceivable substitute for the creation hypothesis, which it holds to be of mythological origin and inexplicable and inconceivable in the light of modern science. To examine it in these aspects will be the purpose of another paper.

ENGINEERING.

SEWERAGE AND STREET PAVING IN KANSAS CITY.

BY ERMINE CASE, JR.

EDITOR REVIEW:—I see the questions of sewerage and of street paving are under serious discussion in Kansas City just now. The first should not be difficult. The general system of sewers should be built at once; be built in the best manner and the cost not counted, only so far as to get good work done at its real value. The district sewers should be ordered immediately thereafter, and every building required to make connections. There should be no hesitation or delay in this matter. Then only will the ponds, the noxious smells, malarial fevers and the cholera infantum disappear.

The determination of the paving question is more difficult, as there will be greater diversity of opinion, less information and a comparatively small number to pay the bills. Information and discrimination as well as economy and honesty should be brought to bear upon its solution. In view of the fact that the material constitutes by far the largest part of the expense of paving, it should be laid down as an axiom in the discussion of this matter, that a city should always use for paving purposes the material nearest at hand, if it be suitable. For this reason the attention of Kansas City is first directed to macadamizing with ordinary limestone. It should not be taken for granted that this is not the best paving for all our streets, business and residence alike. It is certainly far the cheapest, for the material is immediately at hand, and repairing can be cheaply done, so that its durability may be easily maintained. Our macadamizing has thus far been badly done and has never been kept clean. No other paving with the same treatment would be satisfactory. It can not be answered that this method has gone into disuse, for there many prominent streets in London, Paris, Berlin and smaller cities of Europe simply macadamized, although the granite block may be had in almost every hill on the continent.

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However, I think there is a better material even than our hard limestone. The bed of the Osage river from the Trading Post to the Missouri, is full of a gravel that may be safely denominated perfect for the purposes of road-making. At every railroad crossing it may be had in unlimited quantities. It is not the dull, rotten stone-gravel of Ohio, but bright, hard flint, that rings like steel under a wheel, or the shoe of a horse. It does not require quarrying or even screening. There are several railroads crossing these beds, so that no one road can have a monopoly; the best place, however, will probably be Warsaw, less than thirty miles south of Sedalia, the haul being from that point less than one hundred and twenty-five miles. Let our streets be prepared with the usual bed of limestone, and then covered with this gravel, and we shall have a roadway practically indestructible. It can be put down and repaired without the use of machinery or skilled labor. It will produce as little dust and be as readily cleaned as any other pavement. I have no doubt of its being the best for our purposes.

Composition pavements, as used in the European cities, are made of Trinidad asphalt and crushed rock. They are delightful to ride over, and save the wear and tear of vehicle and animal to a very great extent. In icy weather this pavement is objectionably slippery. In Paris it is in use on many heavy business streets, while the Fleet and Cheapside, in London, on which are the heaviest traffic of any streets on earth, are laid with asphalt pavement. It can then be hardly called liable to the charge of want of durability. It would necessarily be more expensive than either of the pavements above mentioned, but the chief objection to it is that repairs are made with difficulty, a patch not being ordinarily successful.

The Granite pavement, or Belgian Block, I see is under consideration, but I do not understand how it can bear the test of comparison The granite must first be quarried, then cut into blocks of even size, and afterward transported twelve hundred miles, each operation being peculiarly expensive. Experts must lay it on an expensive bed, and heavy curbings on each side are required to keep it in place. Nor is that the end, for in New York and all other cities we see as many groups of men at work repairing it as on any other pavement. The wear and tear on horses and vehicles is terrific, ten times more than on any other road, which is no inconsiderable item, while the noise in streets of heavy traffic is a thing to make one shudder. It is true this pavement is more in use in European cities than any other, but that it is not universal, when it can be had, as I have said, in every hill, and labor so cheap, is one of the strongest arguments against its use. For Kansas City to send so far for a material which is liable to such an indictment would seem to be the height of unreason.

Wooden pavements have been discarded everywhere, and for many well known reasons are unworthy of discussion.

If Kansas City must send away from her bluffs for material to make streets, let her bring the gravel from the Osage. I am sure a drive down the Gravois

over this bright ringing metal would settle the question for every one so doing. Whatever may be the pavement of the future in our city, even though it be of solid gold, it may as well be determined that cleaning is absolutely necessary to keep down mud in wet, and dust in windy weather.

INTERLAKEN, Switzerland,
Aug. 23d, 1880.

ENGINEERING PROGRESS IN THE UNITED STATES.

BY OCTAVE CHANUTE, V. P.

Annual Address Read at the Twelfth Annual Convention of the Society of American Civil Engineers, held at St. Louis, Mo., May 25th, 1880.

EXTRACTS.

* * * * * * * * *

The first works in America for the supply of water to towns, were constructed by Hans Christopher Christiansen, and put in operation on June 20th, 1754, at the Moravian settlement of Bethlehem, in Pennsylvania.

The water from a spring, which is still used for the supply, was forced by a pump of lignum-vitæ of five inches bore, through hemlock logs into a wooden reservoir.

The same ingenious Dane, eight years later, replaced this rude pump by three iron pumps of four inches bore and eighteen inches stroke, which for many years were the only machinery for water supply on the Continent, and for seventy years furnished the water for Bethlehem.

Among the oldest, if not the very next in date to Bethlehem, is the Morristown, N. J., Water Company, which was incorporated in 1791, and has ever since furnished the town with water collected from the neighboring hills.

The first application of steam to pumping was in Philadelphia, in 1800, when the third steam engine of any considerable size in the United States was erected on the banks of the Schuylkill. It is believed that these works were the first constructed by a municipality. The first cast iron water pipes were laid in Philadelphia in 1804.

New York was first supplied by a company which erected a small pumping engine about 1800.

During the first thirty years of the century several small works were constructed, among others, at Cincinnati, in 1817; at Detroit, in 1827; at Lynchburgh, in 1828; Syracuse, in 1829; and Richmond, in 1830. Few of these works exhibited any great advance in engineering. The enlarged works for the supply of Philadelphia by water power, constructed at Fairmount, in 1822, showed, however, a marked advance, and were for many years regarded as a model of efficient and economical works. The design and execution of the grav-

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ity supply works for New York and for Boston, between 1830 and 1840, were such as can not be greatly improved, even at the present day, except in minor details.

About 1850 the substitution of light wrought iron pipe, lined inside and out with hydraulic cement, for cast iron, at greatly reduced cost, was found to be practicable in many cases, and the formation of companies to manufacture and lay such pipes, introduced a commercial element into the matter of water supply and led to the construction of many works.

Improved forms of pumping machinery, which performed a fair duty at small expense for construction and maintenance, were designed and their manufacture became a special business.

The careful analysis and investigation employed in the construction of the works for the supply of Brooklyn, between 1850 and 1860, resulted in a more decided advance, in both theoretical and practical science, than had hitherto been made, the effects of which were seen during the succeeding decade in improvements in pipe manufacture, in engine building, in reservoir construction and in maintenance of works.

Between 1860 and 1870, a further impetus to water works construction, was given by the vigorous prosecution of an enterprise for building entire works for direct supply, by pumping into the mains without the intervention of a reservoir. The success attending this enterprise, owing to the small first cost of construction and to shrewd management, created competition, the result of which has been to force the adoption of scientific methods and the employment of skilled engineers, and as a consequence there has been great improvement in the types of machinery and in economical working.

The pumping machinery of large cities has also been greatly improved; the duty now required, and uniformly maintained, being at least fifty per cent. greater than it was thought possible to obtain twenty years ago, or than is now furnished by the less costly "commercial engines," of which two firms alone have built 242 for 168 towns, with an aggregate pumping capacity of 734 millions of gallons per day.

The construction by Mr. Chesbrough of a submarine tunnel for two miles under Lake Michigan, to furnish water for Chicago, was one of the boldest engineering feats of this country. Its successful completion was followed by the construction of several similar works.

On the Pacific coast, the use of unprotected wrought iron pipe for conveying great distances, and under great pressure, has proved very successful.

During the past ten years, the most important work executed, has been the enlargement of the gravity supply for Boston, by the construction of a conduit of masonry, in the designing and erection of which the latest and most perfect methods have been followed. The subjects to which particular attention has been paid by engineers during this period have been the efficiency of pumping machinery, the capacity of gathering grounds, the preservation of the purity of water, and the prevention of waste by consumers.

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All American works are constructed for a constant supply, and most of those first built had a capacity far in excess of the then demand, which caused the formation of habits of wastefulness which it has been found difficult to check when the limit of the capacity was nearly reached.

The magnitude of the interests involved in this branch of engineering, may be judged from the fact that there are now in the United States and Canada 569 towns with a public water supply, having a population of about twelve millions, to whom there are daily distributed over six hundred millions of gallons of water, through thirteen thousand miles of pipes, of which about ten thousand miles are of cast iron.

About one-half of these towns are supplied by gravity, many of them however, having supplemental pumping power. The total capacity of the pumping engines now in use being about 1 900 millions of gallons per day.

Meanwhile improvements in plumbing and house distribution have greatly added to the convenience about our homes, and we now virtually have a spring of cold, and another of hot water, in almost every room of our city homes, to put on tap at will. * * * * * * *

RIVER IMPROVEMENTS.

We have as yet done little toward regulating and improving our rivers. Blessed with a magnificent system of internal navigation, which, as Mr. Fink and Mr. Blanchard have recently shown, virtually compete with and regulate freight upon almost all of our railroads, we have directed our attention rather to the craft that navigate them than to the streams themselves.

The further demand for cheaper transportation, however, as well as the higher spring floods and the lower summer waters, which come with the destruction of the forests, make it necessary that we should within a few years begin extensive river works. Colonel Mason, late member of this Society, showed us in building the St. Joseph Bridge that even the Missouri River was easily controlled, and made to flow wherever the engineer desired, by throwing out cheap and apparently frail brush dikes. A much greater and more original work has since been accomplished by the same simple means by our distinguished member, Captain James B. Eads, who, taking in hand the smallest and most unpromising pass of the Mississippi River, with seven feet of water over its bar, has in four years transformed it into the best access from the river to the sea, with thirty feet of water over the bar, at the cost to the nation of only $5.250,000, while the ship canal which had been proposed by other parties was estimated to cost $10,000,000.

The same far-seeing engineer is now engaged in studying the remainder of the course of the Mississippi River, and devising plans for its control and improvement. You have probably read the report to Congress of the board on which he has been acting, in which, differing widely from their predecessors, they propose to regulate the depth and flow of the river, by reducing its width at those points where it spreads into shallow sand bars.

The reasons by which these proposals are supported seem so sound, that it is to be hoped that our government will soon take steps to test the efficacy of the proposed methods upon an adequate scale.

The first of what is likely to prove a series of works to control the low water discharge of our rivers is being built upon the Ohio River at Davis' Island dam, five miles below Pittsburg. It seems a movable dam, of which you will find a brief description in *Scribner's Monthly Magazine* for this month (May, 1880).

The French have preceded us in works for regulating the flow of their navigable rivers, and have designed a number of types of movable dams (which they call "barrages"), which are well worthy of study and possibly of imitation. We shall doubtless make some changes, and perhaps improvements in them, to adapt them to our necessities and to our constructive methods; and this class of works should hereafter attract the study and attention of the members of profession more than has been the case hitherto.

The boldest and most interesting harbor work now being carried on by our government is probably the removal of the rocky obstructions in the East River of New York, at Hell Gate.

General Newton, as you know, sunk a shaft in the rock at Hallett's Point to a depth of some 50 feet below low water, honeycombed the rock with 7 426 lineal feet of galleries in various directions, and charging 4 427 drill holes in the remaining pillars and roof with 49 915 pounds of "rend rock," "vulcan powder," and "dynamite," blew up the whole Point, extending over three acres, and containing 63 135 cubic yards of rock, on the 24th of September, 1876. So accurately were the explosives located and proportioned, by the mathematical formulæ worked out for the occasion, that not the slightest damage was done to the surrounding houses and premises. The debris has since been removed with a grapple to a depth of 26 feet below low water.

General Newton is now engaged in undermining in a similar manner the rocky island of eight acres (mostly under water) known as "Flood Rock," in the same vicinity. He has sunk a shaft, and driven, to May 1, 1880, 5 273 lineal feet of galleries, from which he has removed 19 044 cubic yards of rock, leaving a roof varying from 8 to 19 feet in thickness between the top of the galleries and the water in the tide way, which is from 6 to 12 feet deep. The holes are all bored by machine drills driven by compressed air.

(*To be continued*).

SHIPS ON WHEELS.

CAPTAIN JAMES B. EADS.

A special meeting of the Chamber of Commerce was held at San Francisco recently, to allow Capt. James B. Eads, the famous engineer, to present his views on the subject of a ship railway, instead of a canal, across the Isthmus. After

referring to the benefits accruing to the State from cheap transportation, Captain Eads said: The wheat surplus of last year, according to figures furnished me by Capt. Merry, was 600,000 tons, and it is estimated that this year the surplus will reach 800,000 tons. The average rate of freight around the Horn is $15 per ton, and after careful investigation it was found that such cargo could be transported by the Nicaraguan Canal at an aggregate cost of $10 per ton, thus saving upon the total annual shipment the large sum of nearly $4,000,000, or fifteen cents per bushel. I am told by some of your intelligent citizens, who have doubtless thought but little upon the subject, that they have grave doubts as to the value of a ship transit across the Isthmus, because it would probably lose to San Francisco the trade of the Orient. But must this trade, which no d ubt benefits this city to some extent, be enjoyed at the expense of the producers of the State? In the $4,000,000 of annual saving to the State to which I have alluded, reference is only made to your exports of wheat. If to this be added the increased value of that which is consumed in the State, and the saving on your other exports, the sum will be found great enough to pay for the cost of a ship railway in four years out of the benefits that will accrue to the people of this State alone. The railway which I propose will not cost more than one-half as much as the canal, and the fares being reduced, a further saving can be effected of $800,000 on wheat shipments alone. The canal would require eight years and the railway but four for construction, a saving in time whose money value to the State would be $20,000,000. The railway proposal may seem rather a wild dream to some, but I assure you it is perfectly practicable. It is not a novel one, having been employed for carrying canal-boats over the Alleghany mountains forty years ago. There is at present in operation within a few miles of Washington a railway upon which canal-boats, heavily laden with their cargoes, are daily transported up a steep grade from the Potomac river to the canal above. In Europe I know of at least two railways of a similar character now in operation. Surely if a railroad can be constructed of sufficient strength to carry a canal-boat, there is no reason why one could not be constructed strong enough to carry on ocean vessel. The work will necessarily be on a very large scale.

The road bed must be very solid, and to distribute the great weight I propose to use not less than twelve rails instead of two, with a multitude of wheels under each car One of the first objections presented to the mind by this plan, is the great weight to be borne by the road-bed. A cradle for a ship and cargo weighing 6,000 tons, would be about 350 feet long, and would rest on twelve rails spaced four feet apart; hence we would have a bearing forty-four feet wide by 350 long, which is 15,400 square feet. This is equal to 780 pounds only on each square foot of the road-bed. A brick wall eight feet high will give the same pressure. On each of the twelve rails, under a cradle 350 feet long, we would have 115 wheels. Each rail would then carry one-twelfth of the 6,000 tons, or 500 tons. This would be about four and one-third tons on each wheel. As the drivers of a large freight engine at rest give a pressure of over six tons each upon

the rail, it will be seen that we really need no heavier rails and ties than are used on first-class railways. With the pressure of the ship thus distributed it is plain that she cannot bend, twist or strain in any way, unless the earth gives way under her, and this is not likely to occur if ordinary care be used in building and maintaining the road-bed. Any inequality in the level of the track can be compensated for by a strong spiral steel spring allowing several inches of play. To avoid bending the ship in changing from one grade to another, the cradle would be run on to what may be called a tipping-table, placed in the line of the railway. This would rest on a fulcrum at the middle and on hydraulic rams at each end, so that the ends could be raised or lowered to conform to the different grades. To avoid curves in the railway, turn-tables long enough to receive the cradle would be placed at necessary points in the main track, and on these the cradle would be turned to the right or left to change the direction of the ship. The cradle will be nothing more than a moveable dry dock. This cradle or dock upon wheels will be backed down upon the railway, on a grade of about one foot in 100, until it reaches a sufficient depth of water to enable the vessel to be floated upon it. When the ship is in position she will be safely secured over the cradle, and then the car will be slowly drawn forward. As the water becomes more shallow, the vessel will naturally take her position upon the cradle; the supports will then be moved up against her hull, while still afloat, so that she can not move on the cradle, and she will be drawn up the incline until she reaches the level track above. Here two powerful engines will be attached, and the vessel will be at once started upon her journey across the Isthmus. At the end of her journey she will be put into the water in the same manner that she was taken out. The objection is urged with great pertinacity that it would be impossible to carry a vessel in this way without straining or injuring her, but the ablest engineers in the world, among them Hon. E. J. Reed, Chief Constructor of the British Navy, have declared that it can be done with perfect safety. The strain could not possibly be as severe as that experienced in rough weather at times at sea. If she bent at all in the direction in which she is most easily bent, longitudinally, she must bend the earth under her. A canal with locks would be a constant menace to your commerce, and an injury to one of the locks would suspend operations on the whole line.

Another strong objection is that a canal, once constructed, can not be enlarged to meet the wants of increasing commerce. No one knows, in view of the progress of ship-building, what the ships of the future will be, and a number of canals constructed years ago, of supposed ample size, are now useless, or nearly so. A tide-level canal, such as M. De Lesseps proposes, would cost from $300,000,000 to $400,000,000, and the cost of maintaining it would be beyond all reasonable estimate. In the report upon the Nicaraguan Canal, recently made to your Chamber of Commerce, it is estimated that 8 per cent per annum could be realized by the company, and the tolls not exceed $2 per ton. This estimate is based upon $100,000,000 as the aggregate cost of the work, which sum

is less than one-third of that required to build the tide-level canal proposed by M. De Lesseps. The annual tonnage to be carried is placed at 1,000,000 tons below that estimated by De Lesseps—namely, at only 5,000,000 tons. Now, if the Nicaraguan Canal Company can pay an 8 per-cent dividend annually by the imposition of a toll of but $2 per ton, the same dividend can be declared by the ship railway upon the imposition of toll of but $1 per ton, for the reason that the cost of the ship railway will not exceed $50,000,000, or one-half the sum required for the construction of the canal; nor will its maintenance and operating expenses be in any greater proportion. I am convinced that the estimate of the cost of constructing the canal at Nicaragua is far below what it will actually cost, and that it can not possibly be built as proposed for less than $100,000,000. Should the proposed work be constructed, it will be found that the cost of improving the harbor at Greytown will far exceed any figure which the sanguine advocates of the scheme are now willing to place upon it. The cost of maintaining its harbors when improved, that of dredging the canal and keeping it and its locks in repair, and a hundred other minor expenses, demand the attention of those by whose products and labor the necessary interest on the capital invested must be paid.

Capt. Eads concludes as follows: "Standing in your presence to-day, and conscious of the full import of my words, I declare to you,

1. That a ship railway can be constructed at one-half the cost of a canal with locks, and in one-half the time.

2. That when completed, the railway can be maintained and operated at a cost not exceeding that of a canal.

3. That your largest vessels, with their cargoes, can be safely carried from ocean to ocean in one-half the time required for a passage through the canal. These considerations alone, it seems to me, should decide you at once in favor of the railway. But these are not the only ones. The railroad, when completed, can be enlarged from time to time, as the wants of commerce may demand. And should the commerce using the road demand a double instead of a single line of tracks, the work can be speedily done and at a reasonable expense, and without interfering with its traffic. Another matter which I desire to suggest is this: Wherever a canal is practicable, a railway is also practicable; and at some points a railway could be constructed where a canal would be out of the question. As you reduce the distance for the carrying of your freight you reduce the cost of transportation. There can be no doubt a ship railway could be constructed at Tehuantepec, and if this route were selected almost 700 miles of transportation could be saved over that necessary if the transit was by Nicaragua."—*San Francisco Chronicle.*

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CULTIVATION AND PRESERVATION OF FORESTS.

Considering the great importance of the preservation of forests, and the lamentable want of foresight which permits their reckless destruction in nearly all parts of the world, but more particularly in our own continent, where forests will soon become scarcer and scarcer unless more practical measures are adopted for their preservation, it is satisfactory to be able to note that some Governments are recognizing the advisability of attempting the preservation of the forests they have under their charge. One of these, we are able to learn from a report published during the late Paris Exhibition, is the Government of France. The document in question, at the time it was issued, did not attract the attention it really deserves, and on that account we refer to it here somewhat fully.

We learn from the report that a large proportion of forest land does not necessarily exclude a numerous population. Compared with Germany, France has a third less of forest-covered soil, at the same time that she has a population less dense by one-eighth. Belgium, Holland, Denmark, and Great Britain, being either countries with a proportionally large sea coast or else islands, with an especially damp climate, may be left entirely out of the comparison, as they are able to exist without extensive forests. But there is no question that the retrograde process of Spain, her less dense population, is due in no small degree to the absence of forests, more especially as the uniformly mountainous nature of her soil requires, more than any other county, the prevalence of forests. Wherever this test is applied, it will be found (of course, speaking only of European countries) that fertility and density of population are closely connected with the presence of forests. It would form a generous undertaking for any Government to aim at an equalization in this direction. Whatever has been done in this respect in all countries has only been effected piecemeal; consequently it has been of but little influence on the whole. A common mode of procedure is what is wanted.

The experience gained by the French Office of Woods and Forests with regard to the acclimatization of foreign, especially trans-oceanic forest trees, is particularly valuable. The blue gum tree imported from Australia prospers in the South of France, and by its plantation at the mouth of the Var the marshes surrounding it have been drained, and the fevers formerly prevailing there banished. The trees prosper wonderfully in Algiers, as the section of a trunk not yet fifteen years old, of a diameter of one foot proves. But the wood is white, light, breaks easily, and cannot be compared with the durable, solid ship timber which the same tree produces in Australia. The same is the case with the American oak, which prospers in poor soil, grows quickly, and forms beautiful tops of foliage. But the wood is inferior, the bark contains less tannin than that of European oaks. Trees, consequently, can be planted in certain cases only as surrogates, principally to prepare the ground for better kinds. At present, experiments are also being made with the Californian theya tree, the wood of which is especially

suitable for better classes of furniture; it is doubtful, however, whether its wood will not deteriorate by cultivation in Europe.

But the most important feature of the forest exhibition was the illustration of the planting of trees in places which require afforesting. This includes two very distinct categories, the afforesting of heights and the afforesting of dunes, as well as their turfing, for trees cannot prosper without the growth of grass. On the heights as well as on the sandy shores of the sea, the labors of the forest cultivator meet with unusual obstacles.

The bare lines of hills have, in winter, a superabundant of snow and water, while in summer they suffer from long-continued drought. By afforesting both evils are to be remedied, but the tree itself suffers most from them. The winds and storms to which the tops of mountains are exposed, and against which the trees are to protect them, as well as the slopes and the valleys which they form, are also a great drawback to the growth of trees. The forester must consequently apply especial means for attaining his object, the afforestation of lines of hills.

There are many depressions in mountains where the evils indicated are not so pronounced, and some protection against wind and too great drought is found. But the water, or rather the masses of water which are collecting in these depressions when the snow melts, have always sought an exit, and as they are acting with continuous and, on that account, resistless force, have found it. Each depression, each sinking of the soil in mountains, has been formed, long before the existence of man, into channels and gorges, whence in spring enormous bodies of water have precipitated themselves into the plains below, carrying with them masses of stone, earth, and roots. The first step, therefore, is to provide the gorge, which very often has been expanded into a valley, with obstacles against the precipitation of water. Weirs are consequently constructed at suitable distances across it. They either consist of a row of strong piles, the intervals between which are filled up by hurdle-work, or a strong, well-constructed dike is built of blocks of rock. The weirs must be made stronger and multiplied according to the length of the gorge and the quantity of water to be met. They retain the water for some time, which forms by its own action a broad smooth course, a small lake; all the small stones and dissolved particles of earth settle down, and soon form a broad, deep layer of fertile soil, on which grow first, grasses, then bushes, and finally trees. Humidity is here longer preserved by the water kept back, and the edges of the gorge afford some protection against winds and a too powerful sun.

As soon as bushes and trees have risen above the weirs, afforestation proceeds and extends rapidly. More fertile soil and humus accumulate, the gorge is gradually filled up, its slopes and edges become covered with grass, and upon grass follow regularly bush and tree. It becomes possible to lead the water from the weir by a horizontal channel over the edge upon the surface of the mountain, or rather the slope, where then the same series of growth is repeated. The verdure and trees already existing afford protection and supply moisture to the plan-

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tations growing on both sides of the filled-up gorge. The mountain thus becomes gradually covered with wood from the gorges. The further bush and tree are extending the longer snow and moisture are kept back, the waters rushing toward the gorge decrease, lose in violence, whereby the matter they carry with them is precipitated, and kept back more completely, and, in a corresponding degree, more nourishment conveyed to the plants. The impetuous mountain torrent, which during the short term of its yearly existence only causes mischief and devastation, is gradually tamed, but it flows during a longer period, for the snow retained by the trees no longer melts all at once. The further afforestation advances the further this development proceeds. Finally, the mountain is transformed into a quiet forest brook, which fertilizes the gorge by degrees almost entirely filled up, and never dries up. The mountain covered with forest makes the precipitation of moisture possible; springs break forth, whose waters seek the bed of the old tumbling and plunging torrent.

In the plain, also, this beneficial change makes itself felt. The never failing brook drives mill and machinery; it serves for the irrigation of meadows, fields, and gardens. On the lower slopes, since afforestation has been effected, vineyards, orchards, or fertile, if rugged, fields have sprung up. The afforested mountain protects from cold, excessive humidity, and exceeding aridity alike, but, especially, also from inundations. It tempers winter, cools summer, and prevents especially, many of the late night frosts which are so destructive to many of the most fertile plantations.

It is principally mountain chains of medium height where such works are possible as we have here pointed out. But lines of hills of small elevation, or swellings of the ground as we meet them in large plains, exert a similar influence on climate and weather if they are covered by forests. A great many will, at the present day, smile incredulously when they read how in the Middle Ages vineyards existed in all parts of Northern Germany, and a not inconsiderable trade was carried on with their products. And yet the explanation is as easy and as simple as it can possibly be. At that time nearly the whole country was still covered by large tracts of forest, the winters were consequently somewhat milder, frosts ceasing earlier in spring. As matter of fact, wherever the vine is cultivated in Germany at the present day, there we find the largest forests. Examples are not rare that as late as this century villages have suffered injury in the cultivation of the vine, or entirely lost it, because forests in the neighborhood have been destroyed. There is no protection in Germany against this wholesale destruction of forests. It is true there is a Ministry of Agriculture, and there are Boards of Health, but there is an absence of legislative enactments for the preservation of forests. It has been repeatedly suggested that existing German forests should be preserved, and, where practicable, schemes of afforestation carried out; at present, however, without any visible effect.

In France the state of the question is in a no more advanced condition. Afforestation proceeds but slowly, and yet France is acknowledged to possess the

best law for afforesting mountains. From 1861-77 but 68,000 acres of mountain land were planted with trees, and further 3,700 acres turfed. The sum expended in those seventeen years was only £345,000, really an absurdly small amount for a country which has spent milliards on the improvement of Paris and other similar outlays, and which is on the point of expending other milliards on railways the utility of which is at least problematical. Need we wonder that inundations occur periodically, every time causing injury calculated by hundreds of millions?

The French law of afforestation already referred to, and passed in 1860, orders in its essential provisions that afforestation is to be promoted by public grants of seeds, young trees, money, and other means. Afforesting, if the state of the soil and other conditions make it appear necessary, may be made compulsory. If landed proprietors, communes, and others interested should decline to undertake themselves a regulated system of afforestation, this may be effected by the State, which may take possession for this purpose of the land in question. If persons interested wish, after completed afforestation, to enter again into possession of their soil, and consequently enter upon the enjoyment of the improvements effected by the State, they must repay to the latter the expenses incurred with interest, or cede instead half of the afforested soil.

The solidification of dunes by means of the growth of grass and the planting of trees offers difficulties of another kind. The question here is to "fix" the sand hills and sand heaps, shifted and driven about by the waves like balls. The work must be very gradual. A whole series of dunes is marked out, the line being drawn, as near as possible, over their crests. The parting off is effected by means of a strong fencing over the crest of the dunes, toward which smaller cross fences lean herring-bone fashion. The effect of this construction is the accumulation of ever increasing masses of sand in the places thus protected, which eventually form a bulwark for the space behind against the rush of the waves. The area thus inclosed is first planted with meadow grass, and next with coniferous trees, the latter being at first protected against sand drifts by means of brushwood. Sedges, broom, esparto grass also have been employed with advantage for first cultivation. The exhibition contained relief plans of the dune works and plantations of the dunes between the mouths of the Gironde and the Coubre. The soil reclaimed lies partly below the level of the sea, and amounts already to many thousand acres. Where, a hundred years ago, there was only a desolate and marshy expanse, there the eye now ranges over splendid forests, in which deciduous trees begin more and more to show themselves among firs and pines, while prosperous looking villages and large herds of cattle, gardens, and vineyards impart life to a landscape which was formerly a silent and dreary waste.—*The Builder.*

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THE CANADIAN PACIFIC RAILWAY.

This work was commenced a year or two ago as a government enterprise, but the Ministry have apparently become somewhat frightened at the magnitude of the task or have become discouraged by the absence of aid from the Imperial Government which was expected at the inception of the undertaking. Be the cause what it may, it has been determined, if the proper parties come forward, to hand over the work to a public company; assistance and inducements being offered to promoters, as was done in the case of the transcontinental lines on the other side of the boundary. The total length of the projected system is 2,200 miles, of which it may be said 600 miles are either completed or under construction. The Government it is announced, are prepared to grant a subsidy of $20,000,000 in cash, payment to be spread over the period of ten years assumed to be necessary for the construction of the line, an amount equal to $10,000 per mile or about one-third of the estimated cost. A further grant will be made of 35,000,000 acres of land, to be located in alternate sections along the route, as was done in the case of the Union and Central Pacific companies. The 600 miles under construction will be handed over to the company without cost.

The history of the undertaking, so far under the direct control of the Canadian Government is as follows: The first expenditure on construction was toward the end of 1874. Contracts were then entered into for the telegraph from Lake Superior to British Columbia along the line of the railway, including the clearing of the forest land to a width of 132 feet. The line was divided into four sections, on three of which the work was prosecuted with vigor and the telegraph completed from Fort William to Edmonton, 1,200 miles, so that messages could be transmitted. The remaining section across the mountains to British Columbia remains incomplete. In the same year (1874) the grading of the Pembina branch for sixty-three miles north of the international boundary was commenced. In 1877 the grading was extended to Selkirk under the same contract, and in 1878 the track was laid on the whole length—eighty-five miles. In 1874 the extension of the Canada Central Railway to the eastern terminus, near Lake Nipissing, was subsidized. Early in 1875 the sections were placed under contract—the one from Fort William, thirty-three miles to Sunshine Creek, and the other east from Selkirk, seventy-six miles to Cross Lake, an extension east of Cross Lake, thirty-six miles to Keewatin, at the outlet of the Lake of the Woods, was placed under contract in January, 1877. In 1876 a contract was made for an extension from Sunshine Creek west to English River, eighty miles. In 1878 the Georgian Bay branch was undertaken; but this work was subsequently abandoned. For the spring of 1879 the line between English River and Keewatin, 185 miles was let in two contracts, and in the summer following a section of 100 miles west of Red River, including a branch from the main line to the city of Winnipeg, was placed under contract. At the British Columbia end of the line, ground was broken toward the close of last year, when the grading, bridg-

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ing, track-laying and ballasting, from near Yale to Savona's Ferry, a distance of 127 miles was placed under contract.

The length now under construction is thus, as under:

	Miles.
Fort William to Selkirk (main line)	410
Selkirk to Emerson (Pembina branch)	85
West of Red River (main line and Winnipeg branch)	100
In British Columbia (main line)	127
Total under construction	722

A second 100 mile section west of the Red River has recently been let, making a total of 822 miles under construction, consisting of main line 720 miles and Pembina and Winnipeg branches 102 miles. In April last the rails were laid 136 miles west of Fort William and 90 miles east of Selkirk, and traffic trains are regularly run from Emerson to Cross Lake, 161 miles.

The cost of the route will, it is said, bear favorable comparison with that of the other completed and projected lines. The general summit is lower and the gradients more moderate. While the Central Pacific in climbing the Sierras, attains a height of over 7,000 feet, and the Union Pacific passes the Rocky Mountains at an elevation of over 8,000 feet, the Canadian Pacific has but one summit on its route, at Yellow Head Pass, where a level of 3,050 feet is reached. The cost of the 406 miles from Fort William to Selkirk, approaching completion, will be about $17,000,000, and for the Pembina branch the outlay has been $1,750,000. For the whole route from Lake Superior to the Pacific coast Mr. Sandford Fleming, the government engineer-in-chief, has made the following estimate, including a fair allowance for rolling stock and engineering during construction:

	Miles.	
Fort William to Selkirk	406	$17,000,000
Selkirk to Jaspar Valley	1,000	13,000,000
Jaspar to Lake Kamloops	335	15,500,000
Lake Kamloops to Yale	125	10,000,000
Yale to Fort Moody	90	3,500,000
Add say	—	1,000,000
Totals	1,956	$60,000,000

The above does not include cost of exploration and preliminary surveys over a wide extent of country between latitude 49° and 56°, along the route, amounting to over $3,000,000, nor the cost of the Pembina branch, $1,750,000 nor other amounts with which the Pacific Railway account of the Government is already charged. In the course of the surveys three alternative routes through the mountains into British Columbia have been laid down in addition to the line as finally fixed to Burrard Inlet. All of these are further to the north than the selected line, and average about 200 miles greater length. They follow respec-

tively the Peace River Pass and the Pine River Pass, and it is recommended that one or the other be constructed when practicable on account of the value of the territory thus to be opened.

The last report of Mr. Fleming also covers urgent recommendations as to the establishment of a Pacific submarine cable in connection with the Canadian Pacific Telegraph system. The cable, it is suggested, may start from one of the deep water inlets at the north end of Vancouver's Island, and be sunk in a direct course to Japan, or it may touch about midway, Ambia, one of the Aleutian Islands. At Yeddo, in Japan, the connection would be made with the Asiatic telegraphs. As an alternative route the submarine may land on one of the Kurile Islands north of Japan, and thence extend direct to Hong Kong. Either course would complete the connection with the whole Eastern telegraph system and effect important results. Such a line would connect all the great business centers of America with China and the principal ports of Asia much more directly than by the present lines of telegraph by way of Europe. The new line would be employed for the most part by the English speaking people of both hemispheres, and the frequent mistakes of polyglot telegraph operators in Europe be avoided. The further inducement is held out that it would bring Great Britain, Canada, India, Australia, New Zealand, South Africa, and all the outer provinces and colonial possessions of Great Britain into unbroken telegraphic communication with each other in entire independence of the lines which pass through other European countries.—*N. Y. Herald.*

ASTRONOMY.

PLANETARY PHENOMENA FOR OCTOBER, 1880.

BY W. W. ALEXANDER, KANSAS CITY.

Mercury sets on the 1st at 6 h. 03 m. p. m., and on the 31st, 5 h. 53 m. p. m. It is unfavorably situated for observation during this month, owing to its being so far south in declination.

Venus sets on the 1st at 6 h. 34 m. p. m., and on the 31st at 6 h. 24 m. p. m., and like Mercury, is too far south of the sun to show to advantage.

Mars is in conjunction with the sun and can not be seen.

Jupiter is in the best position possible for observation, being on the 7th in opposition or 180 degrees from the sun. It rises as follows: On the 1st at 6 h. 00 m. p. m., and on the 31st at 3 h. 52 m. p. m.

The following is a brief summary of the phenomena presented by its four Moons, Io, Europa, Ganymede and Callisto, the time used being Kansas City mean solar time.

On the 1st at 9 h. 30 m. p. m., Io reappears after occultation.

On the 5th at 11 h. 12 m. p. m., a small round black spot will appear on the eastern edge of the planet's disk, it being the shadow of Ganymede, which satellite will follow in 18 minutes, and both will make a transit of the planet's disk.

On the 7th, at 11 h. 50 m. p. m., Io and its shadow will enter on the planet's disk at the same time and pass across in transit.

On the 8th at 11 h. 15 m. 27 s., Io will suddenly reappear, coming out of Jupiter's shadow, and will be very close to the eastern edge of the planet.

On the 9th at 7 h. 06 m. 22 s. p. m., Europa reappears after being eclipsed.

On the same day at 8 h. 28 m. p. m., Io will pass off the western edge of the planets disk, followed in 5 minutes by its shadow.

On the 14th at 11 h. 57 m. p. m., Europa will enter on the planet in transit, followed by its shadow in 23 minutes.

On the 15th at 10 h. 45 m. p. m., Io will disappear behind the planet's disk.

On the 16th at 7 h. 32 m. 07 s. p. m., Ganymede will suddenly reappear at some distance to the east of the planet.

On the 17th at 7 h. 39 m. 26 s. p. m., Io reappears to the east of the planet.

On the 23d at 7 h. 26 m. p. m., Ganymede will disappear behind the western edge of the planet, and at 8 h. 45 m. p. m., Europa will likewise disappear and at 11 h. 33 m. 53 s p. m., Ganymede will suddenly reappear at some distance from the planet on the east side. Europa will likewise reappear at 11 m. 50 s. past midnight.

On the 24th at 9 h. 34 m. 50 s. p. m , Io will reappear after being eclipsed.

On the 25th in the early evening two small round black spots may be seen near the western edge of Jupiter's disk, and at 6 h. 51 m p. m., the one nearest to the edge will pass off followed by the other in 7 minutes. They are the shadows of Io and Europa.

On the morning of the 31st at 1 h. 10 m., Ganymede will reappear, coming from behind the planet and at 1 h. 16 m. 35 s., will plunge into Jupiter's shadow and disappear, being visible a little more than 6 minutes.

On the 31st at 8 h. 50 m. p. m., Io will disappear by being occulted, and reappears from being eclipsed at 11 h. 30 m. 20 s. p. m.

Saturn rises as follows: On the 1st at 6 h. 32 m. p m On the 31st at 4 h. 28 m p. m., and for observation is favorably situated, being in opposition to the sun on the 18th at 6 h. a. m.

This is one of the most remarkable planets in this solar system, being encircled with a system of thin rings extending out in the plane of the planet's equator to a distance of more than 83,000 miles from the planet's center. On the 7th we are 14° 30′ above the plane of the southern surface of the rings, which elevation is slowly decreasing during the next two months, owing to the motion of the earth in its orbit.

Uranus rises on the 1st at 3 h. 43 m. a. m. On the 31st, at 1 h. 44 m. a. m. It can only be seen by morning observers.

Neptune rises on the 1st at 7 h. 15 m. p. m. On the 31st, at 5 h. 14 m. p. m.

Our moon begins its monthly course by passing the sun on the 4th, and Mercury and Venus on the 5th. On the evening of the 7th it will pass 2° north of Antares, the brightest star in Scorpio. On the 17th, at 5 h. a. m., it will pass north of Jupiter 7° 1′ of arc, and on the 18th, at 4 h. a.m., it will pass north of Saturn 7° 44′ of arc. During the month it occultates 13 stars of the 3d to 6th magnitudes.

AN ASTRONOMICAL DISCOVERY.

Professor E. C. Pickering, director of the Harvard Observatory, lately made a discovery which is regarded as one of the most important of the century in stellar physics. In the ordinary telescope a star appears as a point of light, brighter, but not larger than when looked at with the naked eye. Prof. Pickering finds that, on placing a prism between the object glass and the eyepiece of his telescope, the light of a star is drawn out into a continuous band. When, however, the telescope with the prism is directed to a planetary nebula, the light is collected into a star-like point without any band, enabling the astronomer to distinguish instantly between a star and a planetary nebula. This principle has already enabled Prof. Pickering to discover several planetary nebulæ. On Thursday evening, August 26th, an object was observed which presented the appearance of two star-like points within the band in the modified telescope. It is different from anything heretofore observed in the telescope, and is regarded as an important object for investigation.

THE LIGHT OF JUPITER.

There has been for some years a discussion as to whether the planet Jupiter shines to any perceptible extent by his own intrinsic light, or whether the illumination is altogether derived from the sun. Some facts ascertained from spectroscopic observati n by Prof. Henry Draper, and communicated by him to the current number of the *American Journal of Science and Arts*, seem to point to the conclusion that it is not improbable that Jupiter is still hot enough to give out light, though perhaps only in a periodic or eruptive manner. Most of the photographs hitherto made of the spectrum of Jupiter by Prof. Draper, bear so close a resemblance to those of the sun as to indicate that under the ordinary circumstances of observation, almost all the light coming to the earth from Jupiter must be merely reflected light originating in the sun. But on one occasion—Sept. 27, 1879—a spectrum of Jupiter with a comparison spectrum of the moon was obtained by him which showed a different state of things. The photograph which

was taken of this shows, not a change in the number or arrangement of the Fraunhofer lines, but a variation in the strength of the background. These modifications in the intensity of the background seem to Prof. Draper to point out two things that are occurring: (1.) An absorption of solar light in the equatorial regions of the planet. (2.) A production of intrinsic light at the same place. These two apparently opposing statements can be reconciled on the hypothesis that the temperature of the incandescent substances producing light at the equatorial regions of Jupiter did not suffice for the emission of the more refrangible rays, and that there were present materials which absorbed those rays from the sunlight falling on the planet. The strengthening of the spectrum in the portions answering to the vicinity of the equatorial regions of Jupiter, says Prof. Draper, bears so directly on the problem of the physical condition of the planet as to incandescence that its importance cannot be overrated.—*Scientific American.*

BIOGRAPHY.

NORDENSKJÖLD'S LABORS.

BY JOHN RAE, M.D., LL.D., F.R.S., LONDON, ENGLAND.

Before entering upon the Arctic career—which has recently culminated in so grand a success—of the subject of this paper, it may not be out of place to give a very brief notice of his previous by no means uneventful life, for all, or nearly all, of which I am indebted to "The Arctic Voyages of Adolf Erick Nordenskjöld, 1858—1879," published by Macmillan & Co., 1879.

Nordenskjöld is a native of Finland, and was born at Helsingfors, in November, 1832, of a race known for many generations to possess great qualities. Whilst yet a boy, he was an industrious collector of minerals and insects, and accompanied his father, a well-known naturalist, on many of his excursions, thus preparing himself, without being aware of it, for his future great work. At first he was extremely idle when at school, his free spirit refusing to be under due discipline; but when this discipline was relaxed, he became very industrious and attentive, and was soon among those who obtained the best reports.

At this school—the Gymnasium at Borgo—a revolution took place, in 1848, among the pupils, in consequence of two of them being subjected to corporal punishment, and nearly half the young men had to leave the institution—among them Nordenskjöld.

His chief studies in the University of Helsingfors—which he entered in 1849—were Chemistry, Natural History, Mathematics, Physics, and, above all, Mineralogy and Geology. He had already acquired much skill in recognizing and collecting minerals during his father's tours, so that he was at an early age

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found capable of taking charge of the fine mineral collection at Frugord. "By these experiences he acquired a keen and certain eye for recognizing minerals." After passing his examination, in 1853, he accompanied his father on a mineralogical excursion to Ural, and paid much attention to the iron and copper mines. On his return, he continued his favorite studies, and about the year 1855–56, wrote papers on the "Crystalline Forms of Graphite and Chondrodite," "A Description of the Minerals found in Finland," various articles on Mineralogy and Molecular Chemistry, etc.; and also, in conjunction with another gentleman, "The Mollusca of Finland." He was during this time appointed Curator of the Mathematico-Physical faculty, and Mining Engineer Extraordinary, to each of which a small salary was attached.

He did not, however, long enjoy these his first paid appointments, having been removed before his second quarter's salary was paid, because of some political speeches made in "heedless fun and frolic" at a convivial dinner, where one of those present parodied, in a very effective manner, a famous speech of Palmerston's about the taking of the Baltic fortresses. This difficulty ended in Nordenskjöld having to leave his native land and take up his quarters for a time at Berlin, where he continued his pet studies, and made the acquaintance of some distinguished men, to whom his father's well-known name was a most favorable introduction.

He returned to Finland, was offered positions of honor and emolument, but in consequence of an imprudent speech, had again to leave that country for a time; the Governor General, Von Berg, being evidently inimical to him. During this period of exile he made his first Arctic voyage with Torell to Spitzbergen, in 1858, in the autumn of which he again visited Finland, and was offered a situation of trust, but difficulties were raised by Von Berg, to whom he would not express regret for what he had done, and "who told him he must bid good-bye to Finland." He got his passport, and in fourteen days crossed the frontier into Sweden, of which country he became a naturalized citizen. Subsequent to 1862, when Von Berg—who had cruelly denied Nordenskjöld the privilege of visiting his dying mother—had ceased to be Governor General, he was permitted to visit Finland whenever he pleased.

In the season of 1858–9, he was appointed to take charge of the Mineralogical Department of Riks Museum at Stockholm, vacant by the death of the former able Curator, Mosander. His whole history at this time is a continuous record of constant and useful scientific work, showing great capacity and energy, both mental and physical.

In 1864 he went on his first Arctic expedition under his own command, with very limited means, and in a small sailing vessel. The results were much less than were looked for (although during this summer the sea was very free from ice), in consequence of his meeting, when sailing northward, seven boats laden with walrus hunters, from vessels that had been wrecked, with whom he was compelled to return immediately to Norway. The sales of animals, etc., killed during this expedition paid part of the expenses.

A strenuous effort was made by Nordenskjöld, during the summer of 1868, to reach a high northern latitude in the iron steamer "Sofia," * far too weak, both in build and steam power, to contend successfully with the ice-pack usually found north of Spitzbergen; nevertheless, he reached the very high latitude of 81° 42′ N., on the 18th of September, this being the highest well authenticated latitude reached by any vessel (Parry's boats in 1827 excepted) at this date. Later on in the season, the vessel leaked so badly, from a blow against an ice floe, that she was with difficulty brought back to her old anchorage in one of the Spitzbergen harbors, where she was beached and the damage patched up.

On his return from this expedition, Nordenskjöld was awarded the Founders' gold medal by the Royal Geographical Society of London.

I am happy to find that this experienced, truthful, and distinguished explorer is of opinion that, "in a not *too unfavorable* year, it would certainly be possible to reach, from the northwestern extremity of Spitzbergen, a far higher latitude than Sir George Nares' vessel attained during the last English Polar Expedition." †

In 1872, that admirably generous and public spirited gentleman, Mr. Oscar Dickson, again nobly volunteered the funds requisite for another Polar expedition, with the same object as the last, but on this occasion sledging over the ice was to be attempted.

Nordenskjöld closely discussed the question as to whether reindeer or dogs were best as draught animals, and to settle this question satisfactorily he paid Greenland a visit in 1870. So as to utilize this Greenland tour to the utmost, he made an excursion over the inland ice of this ill-named country, which is certainly the reverse of "green." He was accompanied on the ice by the botanist, Berggren, and on this of all places the most unlikely for a botanist to find anything worthy of notice in his own special science, the remarkable discovery was made that this ice was everywhere covered with a scanty vegetation of microscopic algæ. Their progress was interrupted by many crevasses, so that they reached only about thirty miles inland.

Nordenskjöld determined on taking with him reindeer instead of dogs, because they would serve as food, each deer being counted upon as yielding upward of 100 lbs. venison; but the deer required so large a supply of mosses and lichens for food, that an extra vessel had to be hired for their transport.

This year (1872) the state of the ice on the northern shores of Spitzbergen was found unusually rough and unfavorable, and, to make matters worse, the reindeer all escaped very soon after they were put on shore. The auxiliary vessel already mentioned and another which had been required, were to have returned to Sweden immediately after discharging their cargoes, but were unfor-

* An iron steamer is not so good for Arctic service as one built of wood. The cold makes the iron brittle. —J. R.

† This line of route I have consistently advocated for more than a quarter of a century, chiefly on account of Parry's experience of 1827, and because there is, as far as yet known, a channel 300 miles wide for the ice to move freely in, instead of narrow straits leading northward, which, according to my own experience, and that of others, are impenetrably blocked up with ice, either at one end or the other.—J. R.

tunately shut up by the ice in Mussel Bay—an unusual thing—and, not having provisions enough for wintering, the supply of food taken for the crew of one vessel was too small to feed so many mouths; the difficulties were further increased by their being obliged to receive and give rations to a number of shipwrecked walrus hunters, who otherwise would have starved.

The expedition, useful in other respects, was a perfect failure in its main object, that of getting far to north.

As these two last expeditions were wholly with the object of making a great progress Poleward, I shall offer a few remarks on the various routes to the Pole, either already attempted or in prospect, before describing Nordenskjöld's most recent and grandly successful Arctic voyage to the northeast; thinking it may be of interest to those who have not made Arctic voyages especially their study, to point out the various routes to the North Pole that have been attempted, and to mention the difficulties that have been encountered, and their causes, in the efforts to make the northwest passage, which has been discovered, but has never been made in the true sense of the word, that is, by a vessel passing from the Atlantic to the Pacific ocean, or *vice versa*, northward of the American Continent.

Contrary to the theories of many presumably good Arctic authorites, who advocate narrow channels of the sea for Arctic navigation, such channels have, in practice, been found the worst possible for this purpose, especially when their direction lay in anything approaching to a north and south course, as they have always been blocked with impenetrable ice in one part or other. As examples of this, I may mention Smith Sound, which was found completely sealed up by the ice-pack at its northern outlet in 1875. In the narrow Fury and Hecla Strait, Parry's advance westward was stopped by close packed ice at its western opening in 1823.

Franklin's northward progress through Wellington Channel must have been stopped in a similar manner in 1845, for he turned back the same year. In 1846, '47, '48, the ships of the same good and noble but unfortunate navigator were shut up *by* and abandoned *in* the ice, near the south entrance of the somewhat narrow channel, named by me Victoria Strait in 1851; the pressure of the ice-pack coming down from the northwest through McClintock Channel, and checked in its progress by King William's Land, must, from my experience of it, have been immense. Franklin's officers did not at that time know—a fact ascertained by me in 1854—that King William's Land was an island, and that, by passing eastward of it, the ice pressure might in a great measure have been avoided.

Bellot Strait, which bounds the extreme north point of America in latitude 71° 57′ N., was found impracticable by the Fox, in 1858-9, in consequence of the ice-pack at its western end.

Prince of Wales's Strait—another narrow channel—separating Banks Land from Wollaston Land, was of easy access from the south, both by McClure in

1850, and by Collinson in 1851, but its northern entrance was completely sealed up by the ice floes.

Finally, Banks Strait was a fatal obstruction—fatal I mean as regards the making of the northwest passage—to Parry sailing westward in 1819, and equally so to McClure in 1851, '52, and '53, going eastward from Behring Strait, when he had to abandon his ship in Mercy Bay, and with his crew take refuge on board Kellett's vessels, which were also abandoned. They then took passage in an auxiliary steamer to England *via.* Lancaster Sound and Davis Straits, thus making or finding a northwest passage by walking one or two hundred miles over the ice-covered sea.

Sea channels having an east and west direction, when of considerable length, are usually pretty free from obstruction, as the land to the north in a great measure prevents ice pressure from that direction.

An idea has recently been started, and papers have been read on the subject, advocating an advance Pole-ward between the meridians of 50° and 60° east longitude to Franz Joseph Land, which is acknowledged to be *possible* of approach about once in every five or six years. If this assumption is correct, as I presume it may be, because mentioned by the advocates of this route, it must be most dangerous, for, supposing a ship to reach the south portion of Franz Joseph Land in *the* favorable year, she would in all probability be shut up and prevented from getting back for five or six years—a much longer detention than is either safe or desirable.

I have already quoted Nordenskjöld's favorable opinion of the northward route *via* the west shore of Spitzbergen, where we know there is a wide channel of sea as far as 83° north latitude, seen by Parry in 1827. That greatest of Arctic navigators, when in latitude 82° 45′ N., could not find an ice-floe sufficiently large and strong to haul his boats upon, so as to protect them from being nipped, and remarks in his journal, "such was the state of the ice at this my extreme north point"—the fact being that, the farther north he went the smaller and weaker the floes became. This Spitzbergen route has never been attempted by large, well equipped, and powerful screw steamers such as those of Nares in 1875, or like the fine ships now almost universally used by the seal hunters from Dundee and Peterhead.

Previous to his great undertaking which ended so gloriously, Nordenskjöld undertook two preliminary shorter voyages, as it were to feel the way. For this purpose he made a voyage eastward in 1875, with a small sailing sloop of 70 tons burden, crossed the Kara Sea. and reached the Yeniessei River without difficulty, the vessel returning the same season by the same route. Almost everything intended by this expedition was effected—something unusual in Arctic discovery. It being supposed that the cause of success in 1875 was an unusually favorable state of the ice, Nordenskjöld went the following year by nearly the same course in a steamer of 400 tons, and made the voyage with equal success—thus proving, as far as possible where such an uncertain element of obstruction as ice movement is concerned, the practicability of navigating these seas.

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The earliest recorded attempt to find a northeast passage—that is, to take a vessel from the Atlantic to the Pacific ocean, north of Europe and Asia, *via* Behring Strait—was that of Sir Hugh Willoughby, more than three hundred years ago. He and his whole crew were found frozen to death (probably starved), where they had been wintering on the shores of Russian Lapland. This expedition, consisting of three small vessels, sailed in 1553.

A number of other expeditions were sent out in the 16th and 17th centuries with the same object, under commanders whose names appear prominently in our more recent Arctic maps (see Stanford's Circumpolar Maps), the most conspicuous being those of Barentz (a Dutchman) and Hudson. Later on, the Russians undertook the exploration of these seas, and sent out no fewer than eighteen expeditions, all of which failed in their main object. The last of these returned in 1837, on which Von Baer, the Academician, asserted *it was an ice cellar*.

For Nordenskjöld's great voyage, the patriotic and generous Mr. Oscar Dickson, already so frequently mentioned, contributed £12,000, including the purchase of the "Vega," a steam whaler of 500 tons and 60 horse-power, this being a much finer vessel in every respect—apart from the great advantage of steam-power—than was ever previously employed for the contemplated work. By a grant from the king of Sweden of £2,200, and an equal amount from a Russian gentleman, Mr. Alexr. Sibiriakoff, with other subscriptions, the sum of £20,000 was obtained.

The minor objects of this expedition were too numerous to mention in a notice so brief as this; it is sufficient to say that with so experienced and scientific a leader and an admirable staff of able men to support him, no single pursuit that could tend either to the advancement of science or of industrial development was neglected. The expedition was extremely fortunate in having as captain of the "Vega," Lieut. Palander, who, although still young, had already had much experience of ice navigation. The crew of the "Vega" consisted of thirty persons in all, of whom nine were officers and scientists, three Norwegian walrus hunters, and the remaining eighteen picked from about 200 volunteer seamen of the Swedish navy. They were fully provisioned for two years.

The "Vega" sailed from Gottenborg on the 4th of July, 1878, and from Tromsoe on the 21st, accompanied from the latter place by the small steamer "Lena," bound for the river of that name.

On the 30th of the same month, the "Vega" reached the shores of the Kara Sea, and anchored at Chabarova, a Samoyede village, near which the two vessels Fraser and Express had been at anchor since the 20th, and had seen no ice all these ten days. The Lena arrived on the 31st, and both she and the "Vega" took on board coals from the Express, and then sailed on the 1st of August. The whole of the Kara Sea was traversed without seeing ice, except one "drift" of floes too rotten or broken up to impede navigation. On the 6th of August they came near to anchor in Dickson's Harbor, in lat. 73° 25′ N., long. 82° E. (?), having advanced more than 500 miles in six days.

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After spending a day in surveying the harbor, the vessels continued their eastward voyage.

On the 19th of August the first object of the expedition was accomplished, by its arrival at the extreme north point of the Old World, named variously Cape Chelyuskin, Cape Severo, or Northeast Cape, its latitude being 77° 41′ N., longitude 104° 1′ E. On this part of the voyage a good deal of detention had been caused by fogs, but the little ice met with had been either too much decayed or the floes too open to prevent the easy and safe passage of the steamers, being rather an advantage than otherwise, because the water was kept smooth.

A day was spent at this interesting spot in taking bearings and collecting specimens of all kinds. The ships then resumed their route, steering nearly due east away from the land (instead of following the coast line, which here turned to the south), in the direction of the New Siberian Islands; but a dense ice-pack met with on the 22d put a stop to their advance in this direction, and they had to retrace their way, and by the evening of the 23d were again in open water; then, by keeping more to the southward, no more ice was met with up to the mouths of the river Lena, where the little vessel of that name parted company with her larger consort on the night of the 27th, the latter continuing her course toward Behring Strait.

In three days, notwithstanding that there was much time lost in dredging and taking soundings, 360 miles were accomplished, showing how little obstruction there had been by ice, which was, however, seen in greater or less quantities to the north. As they advanced, however, it was necessary to keep to the open channel along the coast, which they had to hug closely, as the strip of water became narrower every hour; yet no serious delay was caused as far as Cape Schelagskoi, which was arrived at on the 6th of September, being still about 500 miles from Behring Strait.

The ice was now found so closely packed, that it was requisite to approach still nearer the coast to find an open channel. Whilst attempting with much difficulty to do this, two large skin boats, of the same build as the Oomiaks of the Eskimos, came off full of natives, the first people that had been seen since leaving Chabarova, about 2,500 miles to the east. These could speak neither Russian nor any other language understood by the Swedes. One boy could count ten in English, showing that they had probably more communication with American whalers than with the Russians. These Tchuktché were found still to use some implements of stone and bone, and their features have an undoubted resemblance to the Mongols of the Old World, and the Eskimos and Indians (?) of the New. Evidently these Tchuktché resemble closely in habits the Eskimos, and preserve like them the contents of the reindeer paunch for food.†

The winter quarters of the "Vega" proved safe, and were in other respects

† At page 385 of "Nordenskjold's Arctic Voyages," he says of the Tchuktches—"a tribe doubtless descended from the Eskimos of Greenland." In my communications with the Eskimos at several positions on the American coast, I was led to believe, from what they told me, that they had migrated from the *West*, and not from the *East*, and therefore the Greenlanders were most probably descended from the Asiatics.

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favorable for comfort and health, being so little to the north, that even on the shortest day—21st December—they had four or five hours daylight. Villages of from five to fifteen tents or most friendly Tchuktches studded the coast, from whom reindeer venison and bear's meat were obtained, being no doubt one of the causes why no symptoms of scurvy made their appearance. These people may he called Marine Tchuktches, in contradistinction to the Reindeer Tchuktches, who wander about from place to place with their herds of tame deer, and who supply the former by barter with the skins of this most useful animal, which form their winter dress. ‡

It is to be regretted that here, as elsewhere, where the civilized man goes, the natives have been taught the love of alcohol, which is especially baneful where this demoralizing drink is used as an article of barter, an offense of which I am happy to find Nordenskjöld was not guilty—only giving "a drop now and then to encourage them." The American whalers bring annually large quantities of spirits to this coast, notwithstanding the prohibition of the Russian government.

The "Vega"was liberated from her ice fetters on the 18th July, 1879; passed East Cape at the narrowest part of Behring Strait, and entered the Pacific on the 20th of July, thus completing the northeast passage—a glorious, and in all probability a most useful work, worthy of this distinguished explorer. The wonderful enthusiastic reception that the Swedish Arctic hero has met with, from the time of his reaching Japan until his arrival at Stockholm, the capital of his adopted country, expresses better than any writing can, how well and truly his work is appreciated.

If I may be permitted to express a regret, it is that Nordenskjöld did not sail from Gottenborg ten or twelve days earlier than he did, because there seems little doubt that, had he done so, he would have completed the passage in the summer of 1878. The Kara Sea was certainly navigable ten days before he traversed it, and nearly all the ice met with was in a decayed state, capable of causing little obstruction in deep water. In fact, its decayed state during the latter part of the voyage, was in a great measure the cause of obstruction, because it floated into much shallower water than the undecayed floes would do, and in a less depth than was required to float the "Vega," and thus her advance was obstructed, as was the case with Captain Collinson's vessel in the autumn of 1853, on the somewhat similar low, flat, Arctic shore of America, west of McKenzie River, when making his way from the east toward Behring Strait.

Whilst on the eastward voyage, early in the seasons of 1850 and 1851, no difficulty was found in making a passage either by Collinson or McClure, because at that time of the year the floes were much thicker and larger, and took the ground in deeper water than was required to float their ships, thus leaving a navigable channel between the ice and the shore.—*London Journal of Education.*

‡ Numerous graves with burnt human bones were found. These were covered first with turf, and then with small flat es.

DEATH OF PROF. S. S. HALDEMAN.

Prof. S. S. Haldeman, A. M., the distinguished scientist, a Professor in Pennsylvania University, died at his home at Chickies, Lancaster county, Pa., September 10th. He was born near Columbia, Pa., in 1812, and pursued his studies at Dickinson College until 1830. In 1836 he was chosen an assistant in the New Jersey Geological Survey, and held the same office in the ensuing year in the Pennsylvania Geological Survey. While engaged in this capacity there he discovered the oldest fossil known at that time, viz.: *Scalithus incaris.* In 1851 he was chosen to the chair of natural history in the University of Pennsylvania and held it till 1855, when he entered upon the duties of corresponding professorship in Delaware College, and later in the same year became Professor of Geology and Chemistry at the Agricultural College of Pennsylvania. At the time of his death and for many years before he was the Professor of Comparative Philology in the University of Pennsylvania, and attended and took a prominent part in the recent meeting of the American Philological Association of Philadelphia. He was the author of numerous articles on conchology, entomology and palæontology, and among his principal papers was his Analytic Ornithological Monograph of the Fresh Water Univalve Mollusca, published in 1840 and 1845; Monography du Genre Leploris, published in Paris in 1847, and papers on Linguistic Ethnology, 1849; Zoölogy of the Invertebrate Animals, New York, 1839, and on the Relations of the English and Chinese Languages, published in 1856. His work entitled Analytic Orthography, which consists of investigations into the philosophy of language, obtained for him in England the highest Trevellyan prize in 1858, over eighteen competitors.

PHYSICS.

FRESHET OF JULY 1880 IN THE MISSOURI RIVER.

The high water of July 1880, was the largest body or accumulation of rain-water in the river at any one time in the last twenty-seven years, and yet in the counties of Lincoln and St. Charles it did not reach the ordinary high banks of the river by thirty inches, or the height of the high water of 1876 by twenty-eight inches.

Many were of the opinion that the river did not have capacity to hold the floods coming down, even before it commenced raining between the Des Moines and Missouri Valleys, but when the series in near succession, of unusual heavy rains came at maximum height of flood, the general opinion was that the river would be higher than in the last three decades.

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Why, admitting the causes stated, did not the river reach the height of '76 or the greater height of '51?

Simply that none of the snow-water mingled with the flood just past. In 1876 from thirty to forty per cent. of the snow that fell during the winter of 1875 and 1876 and drained into the Upper Mississippi, mingled with that flood, hence higher than the flood of 1880. Again it may be asked, why the flood so destructive above, did not reach the danger line by more than two feet in Lincoln and St. Charles counties? The answer is, the greater capacity of the river, which is from one and three-fourths to two and a fourth miles wide in St. Charles, while at places above it is not half that width. And to this fact may be attributed the breaking of the Sny Levee, avarice crowding it out when reserve room should be left for high water.

Most persons interested in the Mississippi Valley are familiar with its present condition, but the physical changes are forgotten, if ever understood by the masses, and that the change is a matter of general interest, will justify giving some of its causes. Twenty-five years back, or in 1855, very little of the land draining into the Upper Mississippi was improved, say between three and five per cent. At that time the population of Iowa was very small; Minnesota and Wisconsin were almost a wilderness, and the dense forests of those States were unbroken except by the bridle or foot-path of the Indians and very few small clearings on the principal streams. The chief physical changes in the last twenty-five years are the gradual lowering of the high water, the lessening of malarial fevers and the climatic changes of warmer summers and colder winters.

The change of temperature of seasons is generally admitted to be caused by the destruction and cutting and clearing of the forests. The decrease of fevers is owing to the increased cultivation of the land, making it porous and absorbent, and the general drainage of the land as cultivated.

The gradual lowering of maximum high water embodies several causes, the chief of which is the cutting of the timber in the heavy snow-belt in the States of Iowa, Minnesota and Wisconsin, that drains into the Mississippi river. When these forests, that have furnished lumber for the valley and country west of the river for the last twenty years, were intact, the heavy snows were shaded and did not thaw until the spring heat got so strong that nearly all the snow was changed to water in a few days—and swelling the streams and rivers so rapidly, that when emptying into the Mississippi they had the appearance of crested waves. Heavy snows rapidly changed into water, and all, centering in the one channel, resulted in high water, and then such high waters reached the wide lower plateaus along the river, when the season was very wet, or in conjunction with very heavy rains, as happened at intervals of fifteen or twenty years, resulted in overflow. The doing away in chief with this cause has been the work of the lumberman and pioneer for the last twenty-five years, as slowly but surely they have been cutting away the great pineries at a rate varying from one to five per cent. a year, so that at this time not more than twenty-five per cent. of the original forest re-

mains in the tributary snow-belt, and the result is, that as the snow is unshaded, the feeble warmth of early spring sun is admitted, it begins to thaw first slowly, but faster as the warmth increases, so that all the snow unshaded is thawed and passed into the streams and small rivers in March to find rest in the Mississippi the early part of April; and the snow thawing so gradually off the lands cleared that it now makes little perceptible change in the river below Keokuk—a fact well known to river men. The quarter of the snow-belt yet shaded (but gradually diminishing) gets to the river about the first of May, to be shaded by the Missouri about the last of May. This gradual outcome of the snow-water is the chief cause of the gradual decrease of the average high water. Next cause in importance is the increase of the cultivation and draining of the land tributary as the surface is cultivated, the absorption is increased, and the ditches pass off quickly what is not absorbed; and as the streams conveying surplus surface water to the river, the lower emptying will keep out of the way of the upper, and the capacity of the river where one and a half to two miles wide, as it is below Cap au Gris, is sufficient to hold extraordinary rain-floods, as demonstrated in the last. Again, as the surface of the ground is cultivated or cleared the evaporation increases, which is no small matter in the extent of area that drains into the valley, and, lastly, the increase of current. In answer to the theory some persons have, that as the timber is cut off the floods are higher, and particularly refer to some rivers in Europe, let me say that such rivers head in mountains, in which the main channel and tributaries have rapid current, consequently rise and fall very rapidly.

THE PHOTOPHONE.

In May, 1878, Mr. Alexander Graham Bell, well known in connection with the telephone, announced before a scientific society in London, his belief that it would be possible to hear a shadow by interrupting the action of light upon selenium. At the recent meeting of the American Science Association in Boston, Mr. Bell read a paper describing at length his experiments in the production and reproduction of sound by light, and the invention by Mr. Sumner Tainter and himself of an instrument for the purpose.

The influence of light upon the electric conducting power of selenium is well known. Mr. Bell found the electric resistence of some selenium cells of peculiar construction only one-fifteenth as much in the light as in the dark. It occurred to him that all the audible effects obtained in the telephone by variation of the electric current by sound waves, could also be produced by variations of light acting upon selenium; and that with suitable transmitting and receiving apparatus voices might be conveyed without a wire along a line of light.

The fundamental idea on which rests the possibility of producing speech by the action of light is the conception of what Mr. Bell terms an undulatory beam of light in contradistinction to an interrupted beam; meaning by the former a beam that shines continuously, but is subject to rapid changes of intensity.

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The apparatus used to give the required undulatory character to light consists of a flexible mirror of silvered mica or thin glass. The speaker's voice is directed against the back of this mirror, as against the diaphragm of a telephone, and the light reflected from it is thereby thrown into corresponding undulations. In his experiments, chiefly with sunlight, Mr. Bell concentrates upon the diaphragm mirror a beam of light, which, after reflection, is again rendered parallel by means of another lens.

The beam proceeding from the transmitter is received at a distant station upon a parabolic reflector, in the center of which is a sensitive selenium cell connected in a local circuit with a battery and telephone. In a recent experiment, Mr. Bell's associate operated the transmitting instrument, which was placed on the top of the Franklin school house, in Washington, about eight hundred feet distant from the receiver, placed in a window of Mr. Bell's laboratory. Through this distance messages were distinctly conveyed by means of light. In his laboratory experiments Mr. Bell finds that articulate speech can be transmitted and reproduced by the light of an oxyhydrogen lamp, and even by the light of a kerosene lamp.

The rapid interruption of the beam of light by a perforated disk gives rise to musical tones, siren fashion. With this apparatus silent motion produces sound, loud musical tones being emitted from the receiver when no sound is made at the transmitter.

The importance of these investigations it is impossible now to estimate. That the photophone can practically take the place of the telephone is not likely, though it is likely to work radical changes in military and other signaling operations. The heliograph, which has proved so useful in recent campaigns in the Afghan country and elsewhere, can now be made to talk orally yet silently over the heads of an enemy or across impassable streams or other low barriers. For rapid communication between distant exploring or surveying stations, the photophone also promises to be serviceable.

Another result of Mr. Bell's researches in this connection is the discovery that many other substances are sensitive to light. He has found this property in gold, silver, platinum, iron, steel, brass, copper, zinc, lead, antimony, German silver, Jenkins' metal, Babbitt's metal, ivory, celluloid, gutta percha, hard rubber, soft vulcanized rubber, papar, parchment, wood, mica, and silvered glass. The only substances found insensible to light are carbon and thin microscopic glass.—*Scientific American.*

DEEP SEA RESEARCHES.

Dr. Carpenter, the great English physicist, has recently published some remarkable results of his elaborate studies of the latest deep sea explorations. The work of the scientific circumnavigation expedition in the Challenger, though completed in 1876, has not until within a few months, if even now, been fully re-

duced, and some of its most important discoveries are now announced by Dr. Carpenter, its originator. One of the first questions its labors contribute to solve is the depth and configurations of the ocean basins.

The prevailing notion of the sea-beds, Dr. Carpenter shows, needs considerable modification, none of them having been carefully outlined, except that of the North Atlantic when sounded with a view to laying the first Atlantic cable. "The form of the depressed area which lodges the water of the deep ocean," he says, "is rather to be likened to that of a flat waiter or tea tray, surrounded by an elevated and steeply sloping rim, than that of the 'basin' with which it is commonly compared;" and he adds: "The great continental platforms usually rise very abruptly from the margins of the real oceanic depressed areas."

The average depth of the ocean floors is now ascertained to be about 13,000 feet. As the average height of the entire land mass of the globe above sea level is about 1,000 feet, and the sea area about two and three-fourths times that of the land, it follows that the total volume of ocean water is thirty-six times that of the land above the sea-level. These deductions, seemingly unimportant except to the votary of science, are destined perhaps to serve the highest practical purposes of deep sea telegraphy. The intelligence now quarried out of the enormous collection of later ocean researches shows the modern engineer and capitalist the feasibility of depositing a telegraphic cable over almost any part of the ocean's floor, and ought to give new confidence in the success of all such enterprises properly devised and equipped. When it is remembered that at the beginning of this century La Place, the great mathematician, calculated or assumed the average depth of the ocean at four miles (or 8,000 feet more than Dr. Carpenter determines it to be from actual survey), and that La Place's conclusion was the received view among scientists until 1850, or later, we get some idea of the advance made in this branch of terrestrial physics by modern research. Not less interesting is a deduction Dr. Carpenter makes from the deep sea temperature observations in the North Atlantic.

In consequence of the evaporation produced by the long exposure of the equatorial Atlantic current, its water contains such an excess of salt as, in spite of its high temperature, to be specifically heavier than the colder underflows which reach the equator from the opposite Arctic and Antarctic basins; and, consequently, it substitutes itself by gravitation for the colder water to a depth of several hundred fathoms. "Thus it conveys the solar heat downward in such a manner as to make the North Atlantic between the parallels of 20° and 40°, a great reservoir of warmth." The climatic effect of this vertical transfer of equatorial heat is obvious. If the great heat-bearing currents which enter the North Atlantic traversed its bosom as surface currents, they would expend their warmth largely in the high latitudes. But, as their heavy and highly heated volumes in large measure descend to the deeper strata south of the fortieth parallel, then stores of tropical temperature are permanently arrested off our eastern coast, and ultimately made subservient to our climate.—*Nineteenth Century.*

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GEOGRAPHY.

ANNUAL ADDRESS BEFORE THE GEOGRAPHICAL SECTION OF THE BRITISH SCIENCE ASSOCIATION, AUG. 26, 1880.

BY GENL. J. H. LEFROY, F. R. S.

In other regions geography was the pioneer of civilization and commerce. Here for the first time she had been outstripped, for the telegraph and the railway had tracked the forest or prairie, and traversed the mountains by paths before unknown to her. Within living memory no traveler known to fame had crossed the American continent from east to west, except Alexander Mackenzie, in 1793. No traveler had reached the American Polar Sea by land except the same illustrious explorer and Samuel Hearne. The British Admiralty had not long before instructed Captain Vancouver to search on the coast of the Pacific for some near communication with a river flowing into or out of the Lake of the Woods. The fabulous Straits of Annian were to be found on maps of the last century. "The sacred fires of Montezuma" were still burning in secluded valleys of Upper California when Her Majesty ascended the throne.

After referring to the memorable expeditions of Franklin and Richardson, of Back, and Simpson and Rae, he proceeded to point out the many agencies of work of late years to open up the continent; the military operations, for example of the United States Government against Mexico; the discovery of the precious metals; the explorations for the Union Pacific and Canada Pacific Railways; international boundary surveys; the geological surveys of the American and Canadian Governments. These had all resulted in a surprising extension of geographical knowledge without any of them having it particularly in view. It was a bold figure of speech of Lord Dufferin's which described the Rocky Mountains in 1877 as being nearly "as full of theodolites as they could hold," but the Dominion Government had spent about three-quarters of a million sterling on explorations or surveys for their railway, and we had only to glance at a recent map to discover nine sovereign States and seven Territories west of the Mississippi, bounded by right lines, which neither war nor diplomacy had determined, laid out like garden-plots, to see that neither Asia nor Africa had unfolded more of their secrets in our times than had the nobler continent where Britain has cast her swarms.

With reference to the survey operations of the Canadian Government in the North-West, where the problem presented was to prepare a vast territory, wholly wanting in conspicuous points, for being laid out in townships of uniform area, and farms of uniform acreage, he said that the law required that the eastern and western boundaries of every township be true astronomical meridians; and that the sphericity of the earth's figure be duly allowed for, so that the northern bound-

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ary must be less in measurement than the southern. All lines are required to be gone over twice with chains of unequal length, and the land surveyors are checked by astronomical determinations.

The sources of the Frazer river were first reached in February, 1875, and found in a semi-circular basin, completely closed in by glaciers and high bare peaks, at an elevation of 5,300 feet. The hardy discoverer, Mr. E. W. Jarvis, traveled in the course of that exploration 900 miles on snow-shoes, much of it with the thermometer below the temperature of freezing mercury, and lived for the last three days, as he expresses it, "on the anticipation of a meal at the journey's end." Mr. Jarvis describes how on one occasion, having walked into a hole concealed by snow, the current caught his snow-shoes, turning them upside down, and held him like a vise, so that it required the united efforts of all his party to extricate him.

The final decision of the Canadian Government to adopt Burrard's Inlet for the Pacific terminus of their railway relegated to the domain of pure geography a great deal of knowledge acquired in exploring other lines—explorations in which Messrs. Jarvis, Horetsky, Keefer, and others had displayed remarkable daring and endurance. They had forced their way from the interior to the sea-coast, or from the coast to the Peace river, Pine or Yellow Head passes, through country previously unknown, to Port Simpson, to Burke Channel, to the mouth of the Skeena, and to Bute Inlet, so that a region but recently almost a blank on our maps, which John Arrowsmith, our last great authority, left very imperfectly sketched, was now known in great detail, and, he regretted to add, the better known, the less admired. The botany had been reported on by Mr. Macoun, and the geology by Dr. Dawson, *pari passu* with its topography.

A discourse on American geography would be incomplete without reference to the great design of piercing the Isthmus of Panama, with which Count Ferdinand de Lesseps had connected his name. Out of the conflict of about ten competing lines the oldest and the youngest alone survive. The route by Lake Nicaragua appeared possible even to Cortez. It was accurately surveyed nearly seventy years ago, and the estimates, although they have grown alarmingly, are still within practicable limits. It had the preference of the highest authorities in the United States. Its total length would be 180 miles, including 56 miles of lake navigation, with a summit level, to be attained by lockage, of 107½ feet. The Panama route would shorten the canal to one-fourth of this length, and it was a cardinal point with its author to dispense altogether with locks. As they were favored by the presence of Lieutenant Bonaparte Wyse—M. de Lessep's coadjutor—he need say no more, except that the enthusiastic reception given to M. de Lesseps in Swansea, not many weeks ago, was sure evidence that this great industrial center took a keen interest in his project from a commercial point of view; and they might safely leave capitalists, engineers, and diplomatists to fight out their own battle, only concerned that by one route, if not by both, the world might reap in our day the vast benefit it already owed, in another quarter, to his genius and indomitable perseverance.

After referring to other fields of geographical interest, he concluded by saying that when the British Association last met at Swansea a generation had passed away. Of the eminent men then present in office, some half-dozen alone remain, and in the retrospect it was so natural to take, the growth of geographical information stood out in remarkable prominence. Still—

"The cosmographer doth the world survey,"

and finds an illimitable field for the improvement of old, or the acquirement of new, knowledge. Better methods of instruction, better books, and, above all, better maps, are changing the aspect of the study to the young; every traveler who settles one question raises others for his successors, so that "no man can find out the work that God maketh from the beginning to the end." Its perpetual youth was the charm of their science; might it also be his excuse.

A vote of thanks was moved to the President for his admirable address.

Sir Henry Barkly, in moving it, expressed his regret that the section would not have the advantage of Sir Henry Lefroy's presence at any other sitting of the section, he being obliged to leave for London to prepare for his immediate departure to Tasmania, of which he had been appointed Governor. He was sure they all wished him and his family a pleasant and prosperous voyage. [Cheers.]

The motion was seconded by Mr. F. Galton and carried by acclamation.

OTHER PROCEEDINGS.

The President then read some letters of a very interesting character from Mr. Joseph Thomson, received by the Royal Geographical Society's East African Expedition. The following are passages from this correspondence:—

"KAREMA, OR MUSAMWIRA, LAKE TANGANYAKA, March 27, 1880.

"I have failed in my attempt to reach Jendwe by way of the Lukuga and Kabuire. I left Kasegna (or Mtowa) on the 19th of January, with all the confidence of a young lion which had not yet known a reverse, and six weeks after I returned to the same place as meek as a lamb. From the very first I had great difficulties with the men, as they believed I was taking them to Namguena, where they would be eaten up. They tried every means in their power to throw obstacles in my way and retard my movements, two of them deserting near Meketo, and the others threatening to do the same. For six days I continued my course along the Lukuga, in spite of their opposition, but I was then obliged to give in. It flows in a general west-northwest direction to that place, and then about west into the great westerly bend of the Congo, all the way through a most charming valley, with hills rising from 600 to 2,000 feet in height. Above the lake the current is extremely rapid and quite unnavigable for boats or canoes of any description, owing to the rapids and rocks. From Makalumbi I crossed the Lukuga into Urua, and struck southwest for the town of Kiyombo, who is the chief of all the Warna on the eastern side on the Congo. I found out, however, I had only escaped difficulties with my men to fall into ten times worse with the Warna.

They turned out to be the most outrageous scoundrels and thieves I had yet met. It is impossible to convey to you the miserable life we led during the five weeks we were in their country. They had not the slightest acquaintance with traders, and they had no respect for the white man. The chiefs demanded exorbitant mhongo, and made us stop wherever they took the fancy. The people were by no means loth to help themselves by tearing the clothes off the backs of the men even in crowds. Several times they turned out to fight us. Arrows and spears have been aimed at me within a few feet; at one village a crowd had got hold of one of my men, and I only forced my way in just in time to deflect a descending axe which would have ended his days; and yet we had to show ourselves firm as well as pacific. The slightest accident or blood drawn, and not a soul of us would have escaped. How we ever escaped with our lives I cannot comprehend. Imagine being awakened in the dead of the night in your tent by your blanket being torn from under you, just in time to catch hold of your azimuth compass and to find your watch gone. Such was one of my nights' adventures. Fortunately they got frightened at the watch, and the chief brought it back next day. These facts will give you some faint notion of our troubles. We reached Mtowa on March 10, destitute of almost everything. To my delight, however, I heard that Mr. Hore was expected every day on his way by canoe to the south end of the lake. On the 23d we started, crossed the lake to Kungwe, and reached Karema on the 1ight of the 26th. As we neared the shore we were hailed by the jolly voice of Captain Carter, whom we found gun in hand and bursting with stories of his wonderful adventures in sport and war, keeping us fixed on our seats all night in his tent as he launched them forth. We went over to visit the Belgian international party at their temporary quarters to-day. Captain Carter had his elephant ready to take us across the marsh. Karema is one of the most extraordinary places for a station that could be found on the lake—a wide expanse of marsh, a small village, no shelter for boats, only shallow water dotted with stumps of rock, no room to be got, and natives hostile; far from any line of trade. The party have commenced building forts and walls, digging ditches in regular military fashion. At the table there sat down an Englishman, an Irishman, a Scotchman, a Frenchman, a Belgian and a German, representing five expeditions, and you will doubtless be pleased to learn that of all these (thanks to yourself) the Scotchman, though the smallest, and having to travel through entirely new country, had been the most successful of all. After leaving Karema we had a moderately good voyage across the lake to Jendwe, at which we arrived on the 7th of April. I was much pleased to find everything in good order and the men all in pretty good health. What annoyed me more was the news that my projected route to Kedwa was impassable. Merere had recommenced the war with the Wabehe, and to pass from the one country to the other would be quite impossible. Under the circumstances there was nothing for it but to down helm and run before the wind with all sails set, with the result of landing me on a route which has now often resounded under the iron heel of the English traveler

—nay, has even shaken under the ponderous weight of the civilized elephant. Still, though driven from my projected scheme, my march from Jendwe has not been valueless. Passing around the south end of Tanganyaka along the shore as far as the mouth of the Kilambo, then striking about N. NE. through Ulungu and Fipa, we reached by easy ascents the town of Kapufi, situated in lat. 8 S and long. 32.25 E. Best of all, however, while at this place I had the honor to settle the problem of Lake Hikwa, or rather Likwa, and give it some shape and place in our maps. It has run itself in the hearsay accounts of successive travelers into various protoplasmic shapes, and, will-o'-the-wisp like, danced about on the map to the tunes of various geographers. I, of course, saw only a part of it, but from what I could gather it must be from 60 to 70 miles in length and 15 to 20 in breadth. It lies two days east of Makapuli, in a deep depression of the Lambalimfipa Mountains. A large river called the Mkafa, which rises in Kawendi, and which by its tributaries drains the greater part of Khonongo and Fipa and Mpimbwe, falls into it. I can almost say with certainty that it has no outlet, certainly not any toward the west. The Kilambo rises near Kapufi. I was surprised and pleased to find that my bearings and estimated distances, as laid down on my sketch map every two days, had actually brought me within one or two miles of Tabora as laid down by Speke and Cameron. I can hardly, however, call it anything but a curious coincidence."

"To the Secretary of the Royal Geographical Society.

"ZANZIBAR, July 19.

"Dear Sir—I have the honor and pleasure to inform you of the safe arrival of the Society's expedition at Zanzibar, in all respects in good condition. Chuma, and my second headman, Makatuba, have worked like heroes, and I should, indeed, be but a poor mortal if I did not acknowledge the fact that the success of the expedition has been to a large extent due to them. Indeed, I can claim but little merit, as the men were all imbued with the idea that I was put specially under their care by the Baluya (Dr. Kirk) to be taken carefully and safely round Central Africa, and then returned safely to Dr. Kirk, to whom they considered themselves responsible for my well-being. As I am just following in the wake of this letter, I have not attempted to enter into any details, awaiting more leisure and the advice of competent men before attempting to put much of my work together. My caravan work has been too much to allow of my making any extensive collections in natural history, but I have still been able to gather a few plants and shells by the wayside, which Dr. Kirk thinks will prove to be interesting and valuable. I am now occupied in paying off my men and settling all accounts, previous to my departure for England, which will be by the mail leaving on the 28th.

"Yours obediently,

"JOSEPH THOMSON."

Sir Henry added that any praise of commendation of the young traveler was almost superfluous. The brave and cheerful spirit in which he described his

adventures, his singular mastery over men, all probably older than himself, proved that he possessed the elements of a strong and vigorous character, from which a career of great distinction might be anticipated. Among the lessons that might be learned was that we might take a more favorable view of the native African character. That his men should have been so faithful to him in so many difficulties and temptations, and that they should have been amenable to discipline under such trying circumstances spoke as much for them as for his own character and power. Mr. Thomson would reach London in November, when he had no doubt he would receive a most satisfactory reception from the Royal Geographical Society.

The last paper read consisted of notes of a journey to the Eastern Siberia across the Amur and Ussuri, by the Rev. H. Landsall, which gave a highly favorable view of prison life in the penal colonies of Russia. Mr. Landsall received a vote of thanks.

CHARNAY'S EXPLORATIONS IN MEXICO.

[Translated from "L'Exploration."]

Late news from Mexico informs us that our fellow-citizen, Mr. Desiré Charnay has signed a treaty with the Mexican government, whereby he is authorized to undertake his explorations and excavations among the ruins scattered somewhat throughout the Mexican territory. Mr. Charnay has immediately commenced his campaign, and a dispatch announces that he has already succeeded in discovering, not far from Mexico, at a height of 4,000 meters above the level of the sea, some archæological riches, comprising tombs, vases and inscriptions of every kind. We have now some details on the problems to be solved:—

A striking particularity of Central American architecture and its ornamentation, is the resemblance, in many respects, to the styles well known to the ancient world, particularly to Eastern Asia.

According to Mr. Charnay, who has recently traveled in Java, the Mexican *teocalis* (houses of God) present some characters almost identical with the temples of Java, and of Cambodge, and Mr. Ferguson, who partakes of this opinion, goes so far as to say that the resemblance between the Boro-Budor and the temple of Tochicalo, or between the pyramids of Suku and of Ojaca is too striking to be explained on the supposition of accidental coincidence. The palace of the governor of Uxmal displays some ornaments which have altogether the aspect of Greek designs. Some magnificent vases, reliefs and busts, Greek at least in style, have been found at Ojaca and in other places. At Palenque some *bas-reliefs* have a character decidedly Assyrian; at Izamal the base of a pyramid presents some gigantic figures which recall the Egyptian Sphinxes, and, in a great variety of forms, is also found the artistic spirit of China and India.

To this accumulation and miscellany of styles is attributable the extreme va-

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riety of theories projected for explaining the origin of American civilization. The idea of some grand emigration from the old world is contradicted by the fact that the primitive races of Central America had no domestic animals; knew but a single cereal and were wholly ignorant of alphabetical writing as well as the use of iron, although they lived where that mineral could be found in abundance. The conclusion to which each one comes depends on the objects which he has exclusively considered, and thus some persons have pronounced, without hesitation, for an indigenous civilization, while others have discerned the signs of an origin, Jewish, Egyptian, Chinese or Tartar, according as they have been impressed by different analogies. There exists but a single means for disentangling this difficulty, and that is direct exploration. The materials yet exist from which one can derive certain information, but the work done so far has been conducted with so little coherency that we do not know the totality of the materials. In directing, properly, the investigation of these places one can hope that it will be possible to determine the relations of the objects to each other, and to fix approximately so as finally to arrive at the essential points of similitude which may exist between the ancient monuments of Central America and those of the ancient world. The present scope of the expedition comprehends the greater part of Central America, so-called properly, or that part of the continent that extends from the Isthmus of Tehuantepec to the Isthmus of Darien. It is here that the ancient civilization attained its highest degree, and where it has left the most imposing monuments of its grandeur.

Squier inclines to the belief that this is the vast center whence primitive civilization radiated. He regards it as the permanent home of the Toltecs, from whom he derives descendants in the Mayas of Yucatan, the Quiches, the Kachiquels and the Chiapas of Guatemala.

Diego De Landa speaking of the prosperous condition of Guatemala, at the epoch of the conquest, tells us that the whole peninsula seemed to form a continuous city, which expression does not seem to pass for a figure of rhetoric, when we take into account the extraordinary number of monuments scattered over the entire extent of the soil. The expedition, in directing its route by way of Ojaca, will examine the sculptures of Mount Alban and the rich mines of that region. Thence it will return to Milta and examine the ornate and massive constructions which were reproduced, with so much delicacy, in a series of large photographs published by Mr. Charnay in 1863. After having passed some time in the mountainous and almost unexplored district that borders Tehuantepec, it will arrive at Palenque. It is expected that this celebrated religious centre will furnish a rich harvest of inscriptions and *bas-reliefs*. Entering Yucatan the expedition will explore some new regions and will penetrate, if possible, into the mountainous country of the warlike Lacandones. A great interest also attaches to its sojourn among the Mayas, who, but a few years ago, made themselves masters of Yucatan and have, it is pretended, reconstructed the ancient cities with their forts and their temples, and have revived many of the customs, laws and idolatrous rites of

their ancestors. Every effort will be made to find some traces, if any yet remain, of the tribes that preceded the Astecs—that is to say, the Otomes—the Chechimecs, and the Olmecs and even a people yet more ancient, of whom sufficient vestiges have been discovered to establish the truth of their existence. Don Manuel Orozco believes that the inhabitants of Mexico comprehend about 120 tribes, and this number must have been more considerable in primitive times. Following the same authority, more than sixty idioms have perished within the limits of the Mexican Republic, and according to Frederic von Hellwald it is very improbable that the inhabitants of the country, in the most remote period, formed a homogeneous population. Of some of the most ancient inhabitants, to whom is attached considerable ethnographic importance, we possess only the names and some traditions of little dependence. Among these tribes are the Olmecs, who, according to the legend, subdued the gigantic race of Quinames and of the Otomes, or Hia Hia, the language of whom has been perpetuated over a large part of Mexico until the present day. The expedition will make every research that can conduce to the object to be attained. It will excavate the tombs and the sacred marshes in which, it is supposed, the faithful have cast their offerings.

J. F.

ITALIAN EXPEDITION IN THE SOUDAN.

Further letters from Dr. Matteucci give some interesting details of the observations made by him in Kerdofan during the march of the expedition under Prince Borghese. In Kordofan, he says, water is as dear as the wine of Barletta. In the rainy season, however, things are different; from June to September almost every inch of the country is covered with water, when if one may not die of thirst, there is a chance of his dying of malaria. Vegetation along the line of march of the expedition was as melancholy and infertile as it could well be; stunted skeleton acacias alternating with a few euphorbias in constant monotony; neither mountains nor hills, and not even plains. In Kordofan the ground presents continuous undulations, no doubt in consequence of the geological formation of the soil, which is a bottom of sand slightly mixed with peroxide of iron. The water of the rainy season is husbanded in wells, but so valuable is it that the expedition had often to force the natives to give them access to these wells.

At one station they found forty wells dug and others in process of being made. When the expedition arrived they found that the Arabs had closed up these wells by means of thorny branches, and had they not used force the whole expedition would have died of thirst.

Kordofan is about 600 meters above the level of the sea, and 380 above that of the Nile. Not a river, not a torrent, not a brook waters this immense territory, which is about 500 miles long and a little less broad. The mean temperature is not less than 92° At the surface the ground is so sandy that animals on the march sink io a depth of thirty centimeters. The rains are irregular and

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never abundant. Some years ago there were no wells in Kordofan; the want of water was not felt, for the natives in the rainy season, collected the water in large reservoirs, and a sufficient quantity was found in them at each station and village. But the seasons even in Africa, tend to change. Eight years ago there was no rainy season in Kordofan, and for several months the people feared they would all die öf thirst. Then they thought of digging wells which gave very good results. Everywhere water was found at a depth of twenty inches. But things have sadly changed during the past eight years, and now, instead of finding water at a depth of twenty inches, it is often not found at a depth of 100 feet. In all the wells Dr. Matteucci found the following succession or strata: From fifty to thirty meters of depth, sand with traces of sulphate of lime; above thirty extends the granite, with a great abundance of quartz in proportion to feldspar and mica. The granite mass rarely extends one meter in thickness, and above is again found the sand. El Obeid, from which Dr. Matteucci writes, is a town of 50,000 inhabitants; there are no Europeans but many Arab traders. Most of the people are natives of Kordofan or Dartur. It is a very lively town, as it is the center of the trade in gum, ostrich feathers and tamarinds. The houses, with the exception of the Governor's, are of straw or earth. In the neighborhood of El Obeid two Roman Catholic missionaries, who seem to reside in the town, have established a station occupied by their married converts. It is a small village of only thirty houses and thirty small families. But Dr. Matteucci regards it as the most satisfactory result yet achieved by the Roman Catholic mission, whose headquarters are at Khartoum. Malbes is the name of the village, and it ls situated in a territory where there are no Mussulman proselytes. Dr. Matteucci is of opinion that such agricultural colonies would make a far deeper impression on the surrounding heathen than any amount of preaching, and strongly advises the mission to develop the system.

THE DUTCH ARCTIC EXPEDITION.

On the third of June the little sailing vessel *Willem Barents* set out from Holland for the third time, to undertake a new exploration in the Arctic seas.

The staff of the expedition, under the command of M. H. Van Broekhuysen, is composed of Lieuts. A. J. Frackers, S. A. Lanne, J. M. Calmeyer and Dr. N. Hamaker, surgeon.

The crew includes a carpenter, a foreman, cook, five sailors and a cabin-boy. In addition, there is on board a marine painter of great talent, M. Louis Apol, who is commissioned to paint among other things a large picture of the Glacial sea for a panorama, which is now being prepared at Amsterdam. The officers, Van Broekhuysen and Calmeyer, the carpenter, Latjens, the sailor, Westerning, and the cabin-boy, Klaas Mantel, were on the *Willem Barents* in a previous voyage. Although a professional naturalist does not accompany the expedition, zoölogical researches will not, for that reason, be neglected.

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The object of this third expedition does not differ essentially from that of the two others. It is, in the first place, an enterprise for practice; in the second place, it is a patriotic undertaking, its object being to continue the work of its ancestors and to render homage to their memory by raising modest monuments in the places which they have discovered and which bear their names; lastly, it does not lose sight of the interests of science, for it is intended to continue researches, discoveries, the operations of sounding, the meteorological and magnetic observations so successfully inaugurated by other expeditions, and, if circumstances will permit, the explorations will be pushed in the direction of Francis Joseph Land, at Barents Harbor, and of the Kara Sea, or in any other direction that is expedient.

The *Willem Barents* left Amsterdam on the third of June by the new canal which connects this city with the North Sea. No news has yet been received from her.

HERMENEUTICS.

THE BIBLE AND SCIENCE.

BY PROF. S. H. TROWBRIDGE, GLASGOW, MO.

The first and chief object of Scripture is to teach man his destiny and his relations and duties to God and his fellow men. While we recognize it to be man's first and highest duty to study the Bible with this end in view, we see nothing irreverent—but rather a privilege and duty—in studying it secondarily, as an exponent of the purest history, rhetoric, literature, morality, principles of practical life, and also as a text-book of science.

It is generally agreed that the Bible was not intended to teach science; and assuredly it was not primarily. But if we study it as a teacher of science we shall find that it yields us no inconsiderable information; and the more we search it for this purpose the more of brilliant and instructive scientific allusion shall we find lurking in it everywhere. And there is no danger that the correctly interpreted Word of God will mislead us into false science.

While we admit that physical science, strictly, has to deal only with physical facts, and Scripture has for its object to teach man the plan of salvation through Jesus Christ, we would allow the widest range in a prescription of the legitimate sphere of each. Let the Bible student study nature to gain a more complete understanding of Scripture, and let the scientist study the Bible for clearer light upon the phenomena of nature. Yet due allowance must be made for the teachings of each out of his special line of study. His authority should be measured by knowledge and reason and not by dogmatic statement. The province of

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each—which is too often forgotten—is to teach *truth* and not to establish pet theories. The theologian *may* give us very poor science, and the scientist *may* give us very poor theology, and there is no lack of evidence that they actually *do;* but we must admit that the field of each is open to the other. Each of the revelations of God to man must be studied in the light of the other; and we dare to affirm that neither can be comprehended in all its fullness and richness without illumination from the other.

There is no conflict, there is no possibility of conflict, between the Bible and science. That many of the interpretations and theories of reputed scientific men are not in harmony with the teachings of Scripture, is fully admitted. On the other hand, it must be admitted that many of the interpretations of Scripture by Bible students are not in harmony with the revelations of science. We must distinguish carefully between *our understanding* of these two revelations and the *correct* understanding of them There is no less reverence than truth in the statement that either may be misinterpreted. But, true as this is on minor points, we have the authority of the sacred Word for it that no *honest* searcher for truth can fail to find in that word light which, if followed, will lead him to salvation and heaven.

That there is no conflict, but the greatest harmony and co-operation between science and Scripture, allow a few illustrations from the many.

Only a few years ago it was almost universally accepted that the earth was only about 6,000 years old. But the discoveries of the geologist led him to conclude that the successive strata of rocks, each containing remains of animals entirely distinct from those in other strata, could not have been deposited in so short a time. And, by carefully studying the statements of Genesis and comparing them with the rocks, it was plainly seen that the Bible record had been misinterpreted; and now friends and foes of the Bible alike agree that the age of the world is indefinitely long, and that the six days of creation were not literal days but periods of vast duration.

For a similar reason, the present estimate of the age of man upon the earth is, by many, being indefinitely lengthened.

It is generally believed that all the races of men sprung from one common pair, in Asia Minor, about 4,000 years before Christ. Yet ethnologists find it extremely difficult to understand how this can be, when apparently unmistakable evidences of man are found in the farthest extremities of the earth, which bear witness that they have a greater antiquity than that assigned to Adam The earliest records of men bearing on this point—which date back from 3,000 to 5,000 years—show that the different races had then as marked peculiarities of form, features and color as they now have. Hence *some* are beginning to conclude that, on this point too, we have misinterpreted the Bible; and, on scrutinizing more closely the Scripture record, they decide—as does Agassiz—that the narrative in Genesis is a history of the origin of only one of the varieties of the human race.

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Isaiah prophesied: "And the Lord shall utterly destroy the tongue of the Egyptian sea." Surveyors for the Suez ship canal route learned the fact, unknown up to that time, that a bar or slight upheaval had become sufficiently elevated to cut off a large narrow body of water from the north end of the Red Sea, to which they saw evidence that it was originally joined. This elevation, which is about ten miles wide, was probably below the surface of the sea at the time Israel escaped from the bondage of Egypt; and, from the best evidence accessible, it is in the immediate vicinity of the locality in which the Israelites crossed, and possibly furnished a highway for them. Thus science throws light upon the Bible.

Christ spoke in parables because the prejudices of most of his hearers would not allow them to profit by undisguised truth. But when his disciples *wanted to understand* the parables, he clearly explained them. There are many obscure references in the Bible to various points of physical science. If they were expressed distinctly the world would not be prepared to receive them. Scientists are, through the study of nature, as we have seen, learning to see the force of some of them. But many scientists, like the most of Christ's hearers, do not try to understand them, they seem to ignore them. Now, if we should as earnestly desire to comprehend these dark allusions as the disciples did to understand Christ's parables, would not the spirit—which Christ promised should teach us all things, and which directs us even in the temporal affairs of life—be given to enable us to comprehend the truths of science through the teachings of Scripture?

Many conclusions have been reached by students of nature which, if the Bible had been accepted as an instructor of science, might probably have been reached much earlier. According to the Nebular hypothesis, the earth was once in a molten state covered with a thin crust, aud this was so completely covered with water that no land appeared. Afterward, as the earth contracted, the crust sunk in some places and was thrust up in others, thus making mountains separated by valleys filled with water. This is clearly explained in Psalm CIV, where it reads; "Thou coverest the earth with the deep as with a garment; the waters stood above the mountains. At thy rebuke they fled, at the voice of thy thunder (doubtless the rumbling thunder of an earthquake) they hasted away unto the place which thou hast founded for them."

It has been known for a brief term of years that there are wind currents from the poles to the equator and that counter currents carry the air back to the poles again. But not till more recently has it been known that thunder showers, storms extending across half a continent, and cyclones, are rotary, and that their winds move in a whirling, spiral motion toward the center. Both of these facts of recent science were, long ago, brought to light by the Preacher in these words: The wind goeth toward the south and turneth again unto the north; it whirleth about continually, and the wind returneth again according to its circuits.

In the very next verse we read: "All the rivers run into the sea, yet the sea

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is not full; unto the place from whence the rivers come thence they return again." David says: "The waters go up by the mountains, they go down by the valleys." Another passage reads: "He causeth the vapors to ascend from the ends of the earth; he maketh lightning for the rain; he bringeth the wind out of his treasuries." Physicists, by laborious research, have learned that water is taken up in the atmosphere in a state of vapor, carried by the winds to the cold summit of mountains, there precipitated in rain, and brought down by the valleys to the sea again. But they have learned, with all their study, little more than was plainly told them in the Bible thousands of years ago.

It is now well known that the earth is the food of plants, and is in these so elaborated that they become food for animals. These plants and animals which feed upon other plants too coarse for us, furnish food for men. Thus science has reached the conclusion that the food which forms man comes from the earth, and the earth is his nourishing mother. But 3,000 years before we learned this, David said: "My substance was not hid from thee when I was made in secret and curiously wrought in the lowest parts of the earth. Thine eye did see my substance yet being unperfect."

After Franklin determined that lightning was electricity, and had invented the lightning rod, the beautiful idea was finally grasped that every pointed blade of grass, and leaf, and twig, directed sky-ward, was practically a lightning rod, and was continually conveying electricity from the clouds. But long ages ago we were told by God's own word that *He* maketh "a way for the lightning of thunder."

Recent scientists claim credit for discovering what they call the law of evolution. But it has been well suggested that the doctrine of evolution was first advanced in these time-honored words: "The thing that hath been is that which shall be; and that which is done is that which shall be done; and there is no new thing under the sun."

The sun's heat is supposed to be the physical cause of the centrifugal force which keeps the members of the solar system from falling into that luminary. The Nebular hypothesis involves the supposition that the sun is losing its heat. Hence it must be losing its repulsive force; and the necessary result would be that planets, as they revolve around the sun, would slowly fall toward it, their orbits making a gradually diminished spiral till they finally reach the sun. The arresting of the enormous motion thus acquired would, it is supposed, produce sufficient heat to melt the whole mass and even dispel it into a Nebulous state again. Is not this quite consistent with the announcement of Scripture: "All the heat of heaven shall be dissolved, and the heavens shall be rolled together like a scroll; and all the host shall fall down as the leaf falleth from the vine, and as the falling fig from the fig tree;" and "the elements shall melt with fervent heat; the earth also and the works that are therein shall be burnt up."

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BOOK NOTICES.

THE NEW TEXT BOOK OF PHYSICS: By Le Roy C. Cooley, Ph. D.: pp. 317, 12 mo.: Chas. Scribner's Sons, New York, 1880.

Doctor Cooley is Professor of Physics and Chemistry in Vassar College, and this little work is the result of his experience as a teacher and an investigator. It is really a second edition of his Text Book of Natural Philosophy, published in 1868. But he has so materially changed the tone of the work, by the introduction of the "principle of energy" into all departments, that he has deemed it proper to give it a new and distinctive title. At the same time much new matter has been introduced, bringing the work fully down to the most advanced scientific applications of electricity and the most recent discoveries in other departments of science.

The work seems to be thoroughly systematized and adapted to the wants of both teachers and pupils. A very noticeable feature is the summing of principal topics and problems at the close of each chapter, for use in reviewing. The illustrations are numerous and new, and the publishers have bestowed much pains upon the mechanical part of the work.

THE UNITED STATES GOVERNMENT; By George N. Lamphere: pp. 297, Octavo: J. B. Lippincott & Co., Philadelphia, Pa., 1880; $3.

The author of this valuable work has for several years occupied a position in the treasury department at Washington, which has given him excellent facilities for familiarizing himself with the workings of the various branches of the government, even in their minutest details, and the information thus gained he imparts to his readers through the pages of the above named volume, in a clear and succinct manner. He has exercised excellent judgment in selecting and arranging the subjects treated, and has thereby compiled a work which contains interesting and useful information for all classes. Beginning with the Declaration of Independence and the Constitution of the United States, with its amendments, he takes up and describes fully the Legislative, Executive and Judiciary departments with all their sub-divisions, including the Department of State, of the Treasury, War, Navy, Interior, Post Office, Justice and Agriculture, the duties of all the principal officers, the organization of their offices, the manner of procedure in the different bureaus, the rules and regulations of the various branches, the origin and history of each department, the pay of officers, fees allowed and a multitude of facts on all points connected with the manner of transacting government business, far too numerous to be mentioned here.

To give an idea of the scope of the work, we will say that over one hundred pages are devoted to a description of the Treasury department and the du-

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ties of the various auditors; sixty to the War and Navy departments; nearly forty to the Interior department, etc.

It will be quite a surprise to most readers to obtain an adequate idea of the magnitude of the details and operations of the government offices as described in this work, and to be informed that they can learn more from it by a careful perusal, which might occupy a few hours, than they could in many months of constant daily investigation in Washington City.

Such a book is of great value to all classes of citizens, for every one has business with the departments which can be transacted just as well by direct correspondence as through an agent or attorney, did the applicant know whom to address. It would be a good text book for the higher classes in our schools, and if kept abreast of the changes in the different departments by means of successive editions, even congressmen and the officers in the different departments, themselves, would find it an important book of reference.

ADAMS' SYNCHRONOLOGICAL CHART OF HISTORY: By S. C. Adams; Published by Jay Andrews & Co., Chicago. For sale at Kansas City, by Rev. J. S. Card, $15.75.

In these days of object teaching, nothing could be more apropos than the introduction of this work; a chart upon which in one picture is shown the history of the world from B. C. 4004 to A. D. 1878. It is a chromo-lithograph, over twenty feet long and twenty-eight inches wide, yet so folded as to be as easily handled as an atlas, each fold turning over like the leaf of a book; or the whole, or any desired portion, can be spread out at a time for examination.

The length of the chart is divided by perpendicular lines into the fifty-nine centuries and their decades; across these century spaces, pass from left to right, colored lines or streams that represent the different historic nations (and lives of the patriarchs), and change their color to indicate every change of rulers; these streams divide, sub-divide, unite or disappear according to the record of the nation represented; thus every nation with its consecutive rulers and all the leading facts of history are placed upon a fixed scale and presented to the eye in their proper relations as to time, just as geographically a map locates towns, rivers, and countries. Meridians intersect places of the same longitude, in the same manner that century and decade lines on this chart mark contemporaneous nations, rulers and events.

The origin of nations, their grand march through the centuries, and their final overthrow, are prominent features, while the confused mass of dates and events that ususlly comprise our knowledge of history, is so sifted and synchronized, so lighted with colors, models and illustrations, that the centuries of the past seem transformed into individual realities, marked with their peculiar characteristics. The plan of the chart is so simple that children can readily understand it, and so comprehensive that it is in itself a historical cyclopædia for the mature scholar.

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So far as we know, this is the most comprehensive and complete work of the kind ever published, and as such it has received the commendations of some of the best scholars in the country, like Prof. McCloskie, Wendell Phillips, Gen. Noyes and Pres. C. H. Payne, D. D., all of whom concur in attributing to it correctness, convenience, and condensation of knowledge to a degree unsurpassed by any other work.

For the use of teachers, students, writers, and for the home circle, nothing equal to it has ever come under our observation. A key, comprising over fifty pages octavo, accompanies each chart, and gives full explanations of the progress of events in each century.

RAY'S NEW HIGHER ARITHMETIC: By Joseph Ray, M. D.: pp. 408, 12 mo.: Van Antwerp, Bragg & Co., Cincinnati and New York, 1880.

While Doctor Ray's name remains upon the title page of this work, it has been so thoroughly changed by the late revision that it is really almost a new book, and should properly be credited to other sources. The complete revision was performed by our own fellow citizen, Professor J. M. Greenwood, to whom the publishers freely express their obligations. Nearly every chapter has been rewritten and much new and original matter has been introduced, and all obsolete matter has been discarded. The result is that it is thoroughly modernized and practical, and just such a guide as the older scholars in the schools need to fit them for the ordinary avocations of business life. At the same time it is so arranged and graded as to fit the student who wishes to do so to enter easily upon a course of higher mathematics. Prof. Greenwood is entitled to and has received the highest commendations for the faithfulness and capability he has displayed in this work.

THE TRUE STORY OF THE EXODUS OF ISRAEL, compiled by Francis H. Underwood, 12mo., pp. 260. Boston, Lee & Shepard, $1.50.

The positive declarations of Dr. Brugsch-Bey in regard to the route of the children of Israel in escaping from Egypt, not by crossing the Red Sea, but by passing northwardly far above the upper end of the Red Sea, between the Mediterranean Sea and what was anciently known as Lake Serbonis, on the flat shores of which the disaster to the Egyptians occurred; thence abruptly turning southwardly at the eastern extremity of the last named lake and reaching Elim, in Palestine, by way of the bitter lakes of Suez and the eastern shore of the Gulf of Suez, have aroused quite a spirit of investigation and inquiry among Bible readers, as well as most other classes of readers, and the compilation prepared by Mr. Underwood from his costly volumes ($12,00) will be gladly received.

It must not, however, be supposed that this question alone is discussed by the editor. He has very carefully extracted from these volumes a large amount of important information upon the origin of the Ancient Egyptians; the division

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of the country; the chronology of the pharaonic history; the early dynasties; art and architecture; Semites and Egyptians; the Pharaoh of the Oppression and of the Exodus, and finally the memoir upon the Exodus read by Dr. Brugsch-Bey before the International Congress of Orientalists in London, September 17, 1874.

Dr. Brugsch-Bey has spent some thirty years in Egypt, and has devoted most of his time to explanations of ancient localities, roads, ruins, monuments and other relics of the earliest times, and has thus become an excellent authority on Oriental history. Still, while his conclusions seem to the reader to be based on correct data, and supported by many facts of modern history, they are not universally accepted by all travelers, nor are his claims to absolute correctness in hieroglyphical translation admitted without dispute by all scholars.

Mr. Greville Chester, who was sent to Egypt by the Palestine Exploration Committee of the Royal Geographical Society, is reported to have discovered that the geographical and physical features of the Serbonis are in actual conflict with Dr. Brugsch's theory, while the well known scholar, Prof. G. Seyffarth, in his article upon Egyptian Theology, declares that Brugsch's knowledge of the Egyptian language is very defective and that he is totally ignorant of the Hebrew.

Leaving such questions, however, to be settled by still closer investigations, it cannot be gainsaid that Mr. Underwood's book is one that contains much that is new to most readers nor that it will stimulate not only geographical exploration, but also Egyptological study from a new and powerful cause.

OTHER PUBLICATIONS RECEIVED.

Report to the Trustees of the James Lick Trust, of Observations made on Mt. Hamilton, with reference to the location of the Lick Observatory, by S. W. Burnham. The Microscopist's Annual, for 1879, with useful tables rules, formulæ and memoranda; Industrial Publication Company, 25 cents. Legal Rights of Children, by S. M. Wilcox, published by U. S. Bureau of Education. Progress of Western Education in China and Siam, and Vacation Colonies for Sickly School Children, published by same. The Western Farmer of America, a free trade tract, by Augustus Mongredien, London, published by Cassell, Petter & Galpin, N. Y. Amended Charter and By-Laws of the Missouri Historical Society, 1880. St. Joseph Medical and Surgical Reporter, Vol. 1, No. 3; J. P. Chesney, M. D.; $1.00 per annum. Daily Programmes of the American Association for the Advancement of Science, F. W. Putnam, Sec.

SCIENTIFIC MISCELLANY.

PRACTICAL FORMULAS.

The following are kindly communicated by Mr. Robert W. Gardner, of this city:

AROMATIC MOUTH WASH.

Tincture of rhatany	4 ounces.
Tincture of cinchona, compound	2 "
Tannin	24 grains.
Soap	80 "
Simple syrup	2 ounces.
Oil of wintergreen, and Oil of Sassafras, of each	8 drops.

DANDRUFF ERADICATOR.

Tincture of cinchona, simple	1 ounce.
Solution of potassa	2 drachms.
Salt of tartar	1 drachm.
Cologne water	1 ounce.
Water, sufficient to make	8 ounces.

Apply to the head twice or thrice a week.

COUNTER IRRITANT EMBROCATION.

Sweet oil	2 ounces.
Rectified oil of amber	1 ounce.
Oil of cloves	1 drachm.

For whooping-cough and bronchitis. To be applied over the shoulder blades, well rubbed in.

NEW MOWN HAY COLOGNE.

Extract of new mown hay	2 ounces.
Cologne spirit	12 "
Imperial cologne	1 pint.
Extract of patchouly	4 drachms.
Water	8 ounces.

Mix, and filter.

VIOLET COLOGNE.

Extract of violet	2 ounces.
Tincture of musk	4 drachms.
Otto of rose	2 drops.
Cologne spirit	12 ounces.
Water	8½ ounces.
Tincture of orris root	1 ounce.
Carbonate of magnesia	1 drachm.

Mix, shake, and filter till perfectly clear.

XUM

RUM AND QUININE HAIR TONIC.

Tincture of red cinchona	3 ounces.
Glycerine	1 ounce.
Jamaica rum	1 "
Tannin	½ drachm.
Imperial cologne, enough to make	9 ounces.

Mix, and if necessary, filter through carbonate of magnesia to obtain it clear. An excellent tonic; to be applied twice a day, rubbing it well into the scalp.

KISSINGEN WATER.

Carbonate of soda	30 grains.
Chloride of sodium	4 ounces
Phosphate of Soda	6 grains.
Sulphate of soda	4 scruples.
Sulphate of magnesia	1 ounce.
Carbonate of Magnesia	100 grains.
Carbonate of lime	140 "
Phosphate of lime	100 "
Muriate of ammonia	2 "

Mix in two pints of water, and add

Tartrate of iron and potassa	20 "
Dissolved in water	2 ounces.
Water	1 gallon.

Charge the mixture slightly with carbonic acid gas, and let it stand over night. Then filter, make up to five gallons, and charge to a pressure of ninety pounds. —*Druggists' Circular.*

A VALUABLE DISCOVERY.

The process, devised by Mr. Bower and perfected by his son, accomplishes the object of protecting the surface of iron, and at the same time produces a beautiful French gray tint, which obviates the necessity of painting the articles treated. The process, which is not secret, consists in heating the articles to be coated in a closed chamber by means of carbonic oxide, heated air being made to enter the chamber for the double purpose of burning the gas and for combining with iron. The excess of air after burning the carbonic oxide gas, combines with the iron, forming first the magnetic oxide and then the hydrated sesquioxide, or common iron rust. By shutting off the supply of air until only enough is admitted to turn the carbonic oxide, the rust is converted into a magnetic oxide. The process is repeated until the film is sufficiently thick for the purpose of protection. The application of this invention has been undertaken on a large scale, the chamber where the oxidation is now carried on being large enough to contain about a ton of miscellaneous articles.

XUM

EDITORIAL NOTES.

A LETTER has been received from Prof. E. A. Popenoe, Secretary of the Kansas Academy of Science, in reference to the coming annual meeting, which will be held at Topeka the second week in November. The academy has sustained severe losses in its membership in the removal by death of Profs. Mudge, Bardwell, Fraser and Kedzie, all of whom have been enthusiastic workers in the society. From the very first Prof. Mudge had sustained the most active relations to the academy. He was the first and last President, and his papers have nearly all been based on original observation, and have formed the most valuable acquisitions to science. Such men are good enough for any age or country, and make the world better by living in it. The academy feels the loss of these active workers severely, but is hoping to have a successful meeting at Topeka, and to send forth a creditable volume of Transactions next spring. The committee on programme will be glad to hear from scientific men in the State, who have anything new to offer in the way of observations or investigations.

THE Boston meeting of the American Association for the Advancement of Science, is spoken of by all returning members, as well as by many of the scientific magazines, as a most interesting and enjoyable one and will long be remembered with pleasure by those who were present.

THE Missouri River Improvement Association held a meeting in this city on Sept. 21st and 22d, which was attended by delegates from Kansas, Nebraska and Missouri, the object being to arouse an interest in the matter of increased facilities for transporting the products of the New West to market and to obtain congressional assistance.

Many of the very best business men of these States were present, and doubtless their action will have the final effect desired. The railroads have opened the country, but are unable to do all the freighting. This movement is not intended to injure them, nor is it a local matter. The whole Northwest is interested in the movement, from Fort Benton to St. Louis. Col. R. T. Van Horn was elected permanent President, and W. H. Miller, Secretary, with Vice-Presidents from all the prominent cities of the above named States.

AN observer need go no farther than the the Kansas City and Bismarck Fairs to learn by their immense exhibits of minerals, cereals, vegetables, animals and machinery, what this region of country is doing in this stage of the world's history, while such exhibits of fossils as those of Professor Snow at Bismarck, and of Sidney Hare, here, tell the story of animal or vegetable life in the remote past, before man's influence upon passing events was felt.

PROF. T. BERRY SMITH, who has furnished several good articles for the REVIEW within the past year, has received the position of Professor of Natural Science, etc., in the Louisiana, (Mo.,) College. Besides being an excellent teacher, Prof. Berry is a writer of ability and taste.

REV. MR. CARD, general agent for Adams' Synchronological Chart of history, which is described in full on page 378 of this issue of the REVIEW, has concluded to make Kansas City his home hereafter, and to devote himself to building up a general subscription book business. He has other valuable works, and expects to employ a number of agents both in the city and the surrounding country.

WE are in receipt of the Proceedings of the Saratoga meeting of the American Association for the Advancement of Science, published by Permanent Secretary, Prof. F. W. Putnam. This volume, comprising

five hundred and seventy-two pages octavo, is mostly made up of papers read at that meeting, though not more than half of those presented were published.

THE following are the contents of the *Popular Science Monthly* for October: Fashion in Deformity, by Prof. W. H. Flower, F. R. S., (illustrated); Coöperation in England, by George Iles; Modern Aspects of the Life Question, by Prof. George F. Barker; The Australian Ornithorhynchus, (illustrated); The mysterious Sounds of Nature, by Robert Springer; The English Precursors of Newton, II; Criticisms Corrected, by Herbert Spencer. I. Tait and Kirkman; India-rubber Industries, by Thomas Bolas, (illustrated;) On the Production of Sound by Light, by Alexander Graham Bell; Education as an Aid to the Health of Women, by Elizabeth Cumings; On the Destruction of Infectious Germs, by Dr. A. Wernich; Possible Efficiency of Heat engines, by Prof. W. A. Anthony; Sketch of George Boole, (with portrait); Editor's Table; Literary Notices; Popular Miscellany; Notes.

THE *Atlantic* for November will contain the first installment of Mr. James's new story, The Portrait of a Lady; and a timely paper (with reference to the recent death of General Myer, and the weather department) on the Future of Weather Prophecy, by Prof. N. S. Shaler. There will be contributions by Miss Preston, Mr. Aldrich, Mr. Lathrop (on the Concord School of Philosophy), with many essays and criticisms.

AMONG the notes on current scientific subjects in the *American Naturalist*, those of Prof. Otis T. Mason, of Columbia College, Washington, D. C., upon Anthropology, are always carefully and discriminately made, causing them to be a marked feature of that interesting journal.

THE articles in the *North American Review* most likely to be of interest to scientific readers, are The Success of the Electric Light, by Thomas A. Edison; The Ruins of Central America, Part II, by Desiré Charay, and Recent Progress in Astronomy, by Prof. E. S. Holden.

THE *Scientific American* raises the question of the safety of New York and Brooklyn in case of an attack by foreign powers, urging that with the most improved modern ordnance a war vessel can throw shot and shell into both cities from a distance of eleven miles and be entirely out of range of any gun now defending the harbor.

The contents of *Harper's Magazine* for October, 1880, are as follows: The Ascent of Fujiyama—C. F. Gordon-Cumming; Art Needlework—Lucretia P. Hale; Keats: a Sonnet—John Tabb; Reminiscences of John James Audubon—Thomas M. Brewer (with two illustrations); A Romance of the Hebrides—Amelia E. Barr (with five illustrations); An Autumn Holiday—Sarah O. Jewett (with four illustrations); A Demon-Hunt with St. Hubert in Touraine—M. D. Conway (with nine illustrations); Does Farming Pay? A Poem—Henry S. Goodale (with six illustrations); The Metropolis of the Prairies—A. A. Hayes, Jr. (with twenty-two illustrations; White Wings: a Yachting Romance—William Black (with two illustrations); The Throckmortons. A Story—Mary N. Prescott; Some Peculiarities of Turkish Politics; Washington Square. Part IV—Henry James, Jr; Is It all There Still? A Poem—Z. B. Gustafson; "Bad Peppers." A Story—George Parsons Lathrop; A Buddhist Vision. A Poem—Francis L. Mace; Modern Bee Culture—M. Howland; Morning and Evening by the Sea. A Poem—James T. Fields; The "Sophia Walker"—Captain John Codman; Editor's Easy Chair; Editor's Literary Record; Editor's Historical Record; Editor's Drawer.